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THE AMERICAN GAS LIGHT JOURNAL

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OBITUARY—JAMES HENRI ROLLINS.

It is with much sorrow that we announce to the fraternity the death, on the evening of June 19, at his home in Oread Place, Worcester, Mass., of Mr. James H. Rollins, whose name and fame had earned for him a prominent place in the ranks of Eastern gas engineers. Of course, we can but sorrow over the gap thus caused in the ranks, still to deceased there can be no question that the ending was release from severe bodily affliction, borne with fortitude and heroism for three long years. The disease from which he suffered was neuritis, or inflammation of the nerves, which is about as acutely painful a malady as the human frame can be called upon to bear. James Henri Rollins was born at Melvin, N. H., in the spring of 1836, and having acquired a common school education, was early attracted to the possibilities involved in the development of the gas business. The first safe record that we have of his connection with the business is his service with the Boston Gas Light Company. Apt and bright, he mastered the details of the craft with such speed that, the opportunity offering, he accepted a contract to build a works at Cairo, Ills. This task completed he returned East to accept a position with the Brookline, Mass., Company, where he remained until October, 1870. At that time an inviting field opened up to him in the shape of the position of Manager and Superintendent of the Minneapolis, Minn., Company, in the service of which he remained 5 years, acquitting himself with signal ability, as the records of that Company amply prove.

In 1875 a call for duty summoned him once more to the East, and in the fall of that year we find him in harness as successor to Mr. F. C. Sherman (who resigned from Worcester in order that he might take service at New Haven, Conn.) as Agent for the Worcester (Mass.) Gas Company. His faithful and valuable labors at this point are too well known to the fraternity to call for extended comment. Suffice it, then, to say that they were of a nature which gave credit to himself, profit to his employers, and satisfaction to the Company's patrons. Failing health alone compelled him (in the spring of 1887) to resign from active duty, and since his retirement, as noted at the beginning of these lines, his failing days have been those of acute bodily pain. His strong mentality, however, remained to the end, and his anguish was, in consequence, all the more pronounced. Ever active in promoting the best interests of his profession, it is therefore not to be wondered at that his name appears on the rolls of several of our Associations, and that it was so written in the early days when many doubted whether or not the policy of meeting in open communion was a safe means for the advancement of gas engineering. Whether or not Rollins was a doubter in this regard is best answered by noting that his name appears on the roster of the American Association at the meeting held in October, 1873, although we believe the first meeting he attended was that held in New York, in 1875. He was an ardent supporter of the Association, and although the only office held by him in it was as member of the Executive Committee ('82–'83), he often assisted in guiding it smoothly in trenchant debate. He was elected to membership in the New England Association at the meeting held at Boston, in 1876, and served on its Board of Directors during 1879, '80, '81 and '82. Here his counsel was often sought, nor was he ever appealed to in vain. He was one of the founders of the Guild of Gas Managers, who perhaps will miss him most, since it was at their gatherings that his genial nature was shown at its best. Of all these organizations he was a member at the time of his death, and it seems superfluous to add that all will miss him sadly.

He was a man of great strength of character and mind, an engineer of marked ability—both executive and technical—whose methods and results were always abreast the times. As a manager he caused everything to be secondary to and for the advancement of the interests of his employers. Honest and trustworthy as an employee, he was equally rated to acquire and retain the esteem and unrestrained affection of his friends. True as steel, his steadfastness to his friends was a type of that manhood which safely passes through the crucible of time; each successive year but proving the fine grain of his affection. In Masonic orders he attained high rank, and claimed kinship with the Quinsigamond Lodge of Masons, Eureka Royal Arch Chapter, Hiram Council and Worcester County Commandery of Knights Templars. The burial services took place at his late residence, on Monday, June 23, the Reverend Dr. Means, of Piedmont Church (of which

Mr. Rollins had long been a faithful member) officiating. A large assemblage was present, and amongst those who assisted in the last sad rites were Messrs. Bill, Learned, Prichard, Coffin, Leach, Andrew, Taber, Quinn, Slater, Rogers, Humphreys, Spaulding, Coburn, Tarbell, Waldo, Langford, Sherman, Spear, Wetherbee, Coggshall, Davis and Lamson—a list that resembles very much the roll-call of the Guild of Gas Managers or that of the New England Association.

Grief we must feel at the death of the gifted and genial Rollins; but may we not temper it in the remembrance of the cessation of his suffering and in the brighter glory that surrounds the memory of those who having worked faithfully and well in life leave to us the records of that life work as mute guides to us in our approach to the revealment of the life that is beyond.

BRIEFLY TOLD.

MR. STEDMAN TELLS THE WHOLE TRUTH.—Not that he does not always do so, but memory cannot always be trusted, when time presses, to report everything and at once. Early last week Col. Stedman paid a brief visit to the JOURNAL office, and in conversation said he expected to pass the summer (or a part of it) in Alaska, whereupon the interviewer got in his fine work, a condensed report of which is to be found in our item columns. Since then, however, we have received a somewhat amendatory letter of explanation as to matters connected with the Colonel's proposed summering in Alaska, and it is so characteristic of him that rather than mangle his words we reprint them verbatim. The letter is under date of the 25th inst., and is as follows:

To the Editor AMERICAN GAS LIGHT JOURNAL: "It occurs to me that in our interview on Monday I failed to give you a complete statement of my purpose in making my journey to Alaska, and that in putting you off with a remark about the glaciers and icebergs I was needlessly leading you into an error which might not accord with the usual reliability of editorial statement in the JOURNAL. Now I will tell you the *whole* truth about it. I am acting in the interest of a Rochester syndicate whose purpose is to obtain, *if possible*, a controlling interest in the Northern Lights and to transfer them to Rochester for its exclusive use in lighting the streets. Of course, we don't expect to confine their radiance within our own civic boundaries. Enough light will probably be reflected from the sky to tantalize the citizens of Buffalo and surrounding cities, and gradually lure them to become residents of a place so blessed as Rochester with its natural and to be acquired advantages; for allow me to introduce Secretary McClintock, of the Rochester Chamber of Commerce. This gentleman is in hearty accord with every measure intended to benefit this beautiful and enterprising city. He is intent on introducing natural gas here, and has already so excited the interests of the natives in the environs of Rochester that several new sources of supply have been *very nearly* discovered in the immediate vicinity. But the Secretary casts his eyes further afield, and in the event of a deficiency in wells which may be driven within a few miles of the city, the pipes will be laid to the big producing fields already developed and a bountiful delivery assured. The same gentleman has another scheme for so hoarding the surplus of the Genesee river as to compel that somewat variable stream to be reliable and constant in its work the year round. An estimate, indorsed by the State Engineer, gives 30,000-horse power per day as the minimum which, under this storage plan, would turn the wheels of our industries every day in the year.

"With heat, power and light thus secured, Rochester will in the next decade enormously outrun its 80 per cent. increase in the last."

THE Messrs. Wilbraham Bros., of Philadelphia, have purchased the patent of the late R. K. Huntoon, of Franklin, Mass., for his gas governor, together with all rights, patterns, stock, etc., and are prepared to fill orders for same.

The Market for Gas Securities.

There is no change of moment in the market for city gas shares. Summer dullness may now be said to have set in. Consolidated is around par, with but few transactions. Mutual is stronger. Brooklyn shares are steady. In our item columns will be found mention of the incorporation of a Company in Trenton, N. J., with a capital of $50,200,000. This Company is the result of certain negotiations that have been in progress for some time whereby English capital becomes interested in the United Gas Improvement Company. The new corporation takes over the capital of the latter, paying therefor at the rate of 200. English and American capital in the venture are about equally balanced. The negotiations were conducted by Sir Henry Goldsmid on behalf of the foreign capital, and Messrs. A. C. Humphreys and Randal Morgan for the Americans.

[OFFICIAL REPORT—REVISED BY THE SECRETARY—CONCLUDED FROM PAGE 881.]

THIRTEENTH ANNUAL MEETING OF THE WESTERN GAS ASSOCIATION.

HELD AT ST. LOUIS, MO., MAY 21, 22 AND 23, 1890.

SECOND DAY—MAY 22—AFTERNOON SESSION.

Mr. E. G. Cowdery, of Milwaukee, Wis., read his paper on

MIXED GASES.

Gentlemen of the Association:—It is but little more than two weeks since I accidentally discovered the announcement in the AMERICAN GAS LIGHT JOURNAL that I was booked to read a paper before this Association upon "Mixed Gases." It had been my intention to give you a paper upon an entirely different subject, and I had so expressed myself to the gentleman entrusted with the records of this body; how he ever got so badly "mixed" over a gaseous subject is beyond my power to explain. Having, then, one thing as a subject and another written, it remains for you to apply the subject as best you can.

My paper was intended to lay before you the result of some practical experiments with "gaseous fuel." The subject of fuel gas has been variously presented to you by different members for the past three years, but it has seemed to me, as it has to many others, that while all these efforts towards solving the question in a theoretical way have beyond question been very able, they have nevertheless lacked enough of the practical to convince many of their ultimate success. For this reason it seemed that the result of a few practical experiments would not come amiss.

To be able to judge how far practice would bear out theory I conceived the idea of trying an experiment to find the comparative heating value of different gases, as it would be accomplished in the ordinary practical way. To do this and make the experiment under conditions as favorable as practice would allow, I had made a pan, 9 inches in diameter and 5 inches deep, with tin sides and copper bottom; this to hold 10 pounds of water, and to be used over a gas stove having an equalized flame spreading over a diameter of 5 inches. With 10 pounds of water in the pan, a thermometer suspended so that the bulb was in the center of the body of water and the top of the dish covered with glass, the gas was lighted and as soon as the mercury reached 70° the statement of the meter was taken. When the mercury reached 210° the gas was shut off. If there had been 4 feet of gas used to raise this 10 pounds of water 140° the 4 feet would have raised 1 pound of water 1,400°, or 1 foot would have raised 1 pound 350°. We judge from this that we have obtained in practice 350 units of heat from 1 foot of the gas; the balance of the theoretical heat units in the gas was, of course, wasted.

Care was exercised in obtaining the proper length of time to raise this body of water 140° in temperature with the minimum waste of heat, which in this case was found to be about 20 minutes. The gas stove was so constructed as to allow of adjustment of air and gas separately. These were so adjusted for each gas tried as to produce the best result. The following results were obtained:

Ordinary coal gas, 16 to 17-candle power	311 units.
Uncarbureted water gas (no air)	157 units.
Carbureted water gas, 25 to 30-candle power	408 units.

It was found that the burner we were using for the uncarbureted water gas was not best adapted for it, and another was substituted, which is specially made and adapted for that gas.

The results for coal gas were also improved by using a different burner. With these improved burners the results from the same gas were:

Uncarbureted water gas (no air)	183 units.
Coal gas, 16 to 17 candle power	345 units.

It happened at this time to be convenient for me to test with the same apparatus in the same way a fuel gas said to be a combination of coal gas and uncarbureted water gas, and, of course, superior in heating qualities to uncarbureted water gas alone. The result was as follows:

With original burner	127 units.
With special burner	153 units.

Against uncarbureted water gas straight:

With original burner	157 units.
With special burner	183 units.

The so-called fuel gas in this case was 16 per cent. less in heating quality than the straight uncarbureted water gas.

With this result of a practical experiment with various gases, with the same apparatus and under precisely similar conditions, and so nearly

bearing out the theoretical comparison, what conclusions are we to draw? Simply that we must accept the comparative values placed below as facts, with the value of

Uncarbureted water gas placed at	100
Ordinary coal gas, 16 to 17 candle power, will be	200
Carbureted water gas, 25 to 30 candle power	250
Mixed, ¾ coal, ¼ water gas	215

So far, where "fuel gas" has been practically applied, the products of combustion, either partially or altogether, have been thrown into the heated rooms. No doubt this was done to save heat; for if we aim to attempt to reach a price equal to the cost of coal every available means must be taken to reduce the waste heat to the minimum. I do not hesitate to say that I believe any scheme which fails to dispose of all the products of combustion is doomed to absolute failure.

Believing this, I set about devising a way to heat the office building at the works in our city the past winter, and carried out a plan, which was perfect in its plan for heating, which disposed of all the products of combustion by throwing them into the chimney and which reduced the waste of heat to the minimum, as they never entered the chimney above 75°. It was a hot water circulating system, direct radiation, and I believe for either gas or for coal is the cheapest system of heating to operate. A boiler or heater composed of copper tubes was built for the purpose and so arranged that the gas flame played upon the upper portion of the coil, the products of combustion being drawn down through the heater around the tubes by the draft of the chimney, thus coming in contact with the coldest water before entering the chimney. As the temperature of the water entering the heater at the bottom was never above the temperature of the room, the products of combustion could not enter the chimney at a higher temperature. The room heated was 43 × 24 feet and 12 feet high, equaling 12,384 cubic feet of space. To get a comparison with coal I commenced burning anthracite coal at my house on the 1st of November last, the same day as these gas heaters were put into operation. As both buildings are solid brick and about equally exposed, and the rooms in each case 12 feet high, I consider the comparison very fair. The space heated with coal equaled 53 feet by 33 feet and 12 feet high, and equaled 20,988 cubic feet of space. From November 1st to March 15th we burned at the one place 57,500 feet of gas, at the other $9\frac{2}{3}\frac{5}{0}\frac{0}{0}$ tons of anthracite coal.

Again: At one place, 4,643 cubic feet gas to heat 1,000 cubic feet space; at the other, 917 pounds coal to heat 1,000 cubic feet space. It thus appears that 10,000 cubic feet of gas equaled, in this case, 1 ton of anthracite coal. As it took 4,643 cubic feet of gas to heat 1,000 cubic feet of space for 4½ months, and these the coldest months of the season, it certainly would not increase the proportion for the remaining 1½ months. Allowing the same proportion, it would cost $4 per 1,000 cubic feet of space for a season of 6 months, from November 1st to May 1st, for gas at 65 cents per 1,000 feet, and same price for coal at $6.30 per ton. As the gas we were making the past winter was three-fourths coal gas and one-fourth water gas, and had a comparative heating value of $2\frac{1}{1}\frac{5}{0}\frac{}{0}$ times uncarbureted water gas, its value would be placed at 75 cents, against uncarbureted water gas at 30.

As Mr. Evans is selling an uncarbureted water gas at 30 cents, and as he stated in his paper at the Ohio meeting, recently, that at that price for his gas, it cost about $4 per 1,000 cubic feet of space heated, it appears to me that these figures are somewhere near reliable. I should have stated that the coal was used in a new and what appears to be a good hot air furnace.

I do not know that any of us care to, or can afford to sell our illuminating gas at 65 cents per 1,000 feet; but if we cannot, then we certainly cannot afford to sell uncarbureted water gas at 30 cents. If we can get 40 cents for an uncarbureted water gas—which we ought—and can, at that figure, make a profit, we can make a larger profit in selling illuminating gas at 80 to 90 cents for the same purpose.

It is no argument that a fuel gas plant making uncarbureted water gas would require less capital in the works; for this would be more than offset by the additional cost of mains to carry twice the amount of gas.

It is an inevitable fact that so far as we have progressed at present, a successful "fuel gas" must be some kind of an illuminating gas.

The President here intimated that the Association was pressed for time, and suggested that as the paper by Mr. Somerville was somewhat in the nature of the one read by Mr. Cowdery, that the Somerville paper be read so that a joint discussion might be held. This was agreed to, and Mr. James Somerville, of Indianapolis. Ind., read his paper on

THE EFFECT OF NATURAL GAS COMPETITION.

This paper, on the "Effect of Natural Gas Competition," can only interest those of our number who are enjoying the blessing of this most wonderful of Nature's products. The Committee were kind enough to suggest the subject to me, and as I happen to be one of those unfortunate people who have a peculiar difficulty in saying "No," at the right time, I had just to comply with their suggestion.

It is a little over two years since natural gas was introduced into our city, giving it ample time to show its effects as a competitor with the manufactured article. The natural gas is found in great abundance at a point 20 miles distant, and is brought to the city by three lines of pipe. One line is part 16-inch and part 12-inch; the second line is all 12-inch; the third line is part 8-inch and part 10 inch. The pressure at the wells is 300 pounds to the square inch, and it is estimated that these three lines of pipe will deliver into the city forty million cubic feet per day. The illuminating power of the gas is 9.5 candles. Its specific gravity is .570. It is practically free from impurities. When first introduced it showed decided traces of sulphureted hydrogen, turning the test-paper black the moment it was applied. But about one year after its introduction, from some cause which I am unable to explain, it ceased to show the slightest trace of this impurity. There were four companies organized to supply the city, but only three of them went to work. So great was the desire of the people for the new and cheap fuel that they readily granted the freedom of the city to the companies, and the contractors took full advantage of that freedom. The way the streets were torn up, ditches left open for weeks, entire squares of the city cut off from traffic, was somewhat surprising to the regular gas man, who had been accustomed to conduct his main-laying with the fear of the municipal authorities before his eyes. It was the great desire of the companies to get into the creamy part of the city first. The better and least expensive plan would have been to have given each of the companies a district to itself, as the price of gas was fixed by ordinance. But as this was not done, we have often three main-pipes in one street, when one would have been sufficient.

I found it next to impossible to properly watch and protect our mains and services during these operations. A number of gangs would be working at once in different parts of the city, and if a service-pipe came in the way of their main, the handy crow-bar was brought into requisition with telling effect. The service-pipe would either be broken or pulled clean out of the main and covered up, to be revealed in the near future in the usual way. I must give the companies credit, however, for doing the best they could under the circumstances to protect our property, and when we presented the bill for repairing the damages they paid it without a murmur.

Before the natural gas was turned on the mains were all carefully tested. The high pressure mains, which encircle the city, had to stand an air pressure of 80 pounds to the square inch. The low pressure, 15 pounds to the square inch. The city engineer, to whom was intrusted the testing operations, performed his duty faithfully and well. The consequence is, we have had no accident whatever from leaking main-pipes. The gas is burned at a pressure of 7 oz., equal to a water column of 13 inches in height.

The great number of houses waiting to be fitted up for the use of the new fuel brought a host of gas-fitters from all parts of the Union, chiefly from the natural gas regions. Every person in the city who had ever handled a pair of pipe-tongs turned gas-fitter. It was not an unusual occurrence to see the shoemaker take down his sign which read "Boots and Shoes Neatly Repaired," and put up one with this legend on it, "Natural Gas Fitting Done on Short Notice." Of course it was impossible to control such a crowd or specify the size of pipe to be used, for they went into the lighting business also. But natural gas companies took in the situation, and promptly issued an order that no gas should be turned on unless the occupant of the house had a certificate, signed by their inspector, to the effect that the fittings had stood a pressure of 10 pounds to the square inch. The order was faithfully carried out, and I have known instances where the fitter would spend two days in fitting up the house and be occupied four and five days in stopping the leaks. The troublesome mercury would insist upon obeying the laws of gravitation.

When the work of fitting up 10,000 houses was completed the business began to slacken, and the question of earning an honest penny by our army of gas-fitters was an important one. They went from house to house amongst our customers, representing that the natural gas was just as good for illuminating purposes as the artifical. This plan met with considerable success. The method they employed was to shut off our gas, disconnect the meter, connect the riser to the natural gas pipe, remove the burners and put in their place the Jumbo burners. We lost for a time by these means some 500 consumers. Nearly all the stables, workshops, cellars, small stores and other places, where a good light was not an absolute necessity, adopted the Jumbo burner, which is a common flat flame, consuming from 10 to 50 cubic feet per hour. Apparently the natural gas companies made no conditions, for the consumer uses these

burners night and day for the sum of 15 cents each month. For a heating or cooking stove, which consumes about the same amount of gas, the companies receive $1.50 per month. During the hot weather the heat from these large burners is very oppressive, but a number of people are willing to put up with a little discomfort of that kind for the sake of cheapness. As we anticipated, we lost our entire day consumption for cooking and heating purposes. There was no competition. It was a clean walk over the course with natural gas. It burns just as well in a common gas stove as our gas does. The stove requires no alteration whatever. Where the gas stove is not connected with the natural gas it is carefully put aside for future consideration. As some of you know, we had by some energy and perseverance built up a remarkable stove consumption; fully 10 per cent. of our output was used for cooking and heating purposes. Therefore we gracefully yielded to the inevitable. In other words we could not help ourselves.

Numerous devices for carbureting the natural gas, and thereby increasing its illuminating power, were experimented upon and brought out by a number of hopeful inventors. But, from some cause or other, these inventions have not proved successful. The gas thus carbureted was consumed in an Argand burner, and the fluctuations of the flame were very marked, arising either from the alteration of the specific gravity or from uncontrollable pressure. There was also some danger and trouble in handling the carbonizing material. These causes, with the liability of the chimneys to break from the intense heat, proved fatal to the success of this plan, for, I observe, in these days the people desire to have their artificial light with as little trouble as day light.

Natural gas has proved a veritable godsend to the Welsbach lamp. As you are all aware, this burner is of the incandescent order, and only requires heat for its successful operation. On the introduction of natural gas a company was immediately formed for the sale of this lamp. They charged $2.50 for putting it in position. The gas cost 25 cents per month for each burner. It is claimed that the company sold 3,000 at these figures. This method of introducing the lamp did not apparently prove a financial success, for the company gave us several opportunities to purchase the sole right to use it. Our chief reason for declining to purchase was, if it was a good and cheap burner, we did not desire to place any obstacle in the way of the people having the full benefit of it. Recently one of the natural gas companies (the Consumers Gas Trust) bought the Welsbach people out, and the lamps are now being put in free of charge. They rent them for the average sum of $2 each per annum. The gas is included. The conditions are that the contract is to be of one year's duration and the lamp to be returned in good condition, the consumer paying for all renewals and broken chimneys. The lamp gives a beautiful, soft, white light, and is well adapted for desk purposes where the person can get near enough to it, for, like all other incandescent lamps, it is very deficient in diffusive power. Much disappointment has been experienced by placing one on the usual store pendants. It requires two, and in some instances three, to diffuse the same amount of light as a common 6-foot jet of 18-candle gas, and at the exceedingly low price at which they are offered the consumers can afford to put up a sufficient number of them. There must be from 7,000 to 8,000 of these lamps in use at present; but it must not be understood that they have displaced a like number of our lights. At least one-third of that amount are being used by people who never burned gas before. No meter is used for these lights, and no limit is placed to the number of hours burning. Like all human inventions, the lamp has its drawbacks. The mantles require to be renewed once a month. The chimneys have to be kept clean, which, if neglected, reduces very materially their illuminating power. There are some other burners in this fruitful field, but I have only mentioned those that may fairly be called competitors.

In conclusion, it may be asked, What have we done to meet this extraordinary competition? We have done nothing more than we have always done these many years—sending out a pure 18-candle gas at as low a price as we could, cheerfully taking out a meter at the request of the consumer, and as cheerfully putting it back again; promptly attending to the wants of our customers, and treating them the best we knew how.

The law of compensation to some extent comes in here, as in other cases. Natural gas is an ideal fuel. We use it entirely under our benches and boilers, with a consequent reduction of labor. We sell our coke at a fair price in those benighted localities that are less favored by nature than we are, and with a reasonable price for our other residuals we manage to put our gas into the holder at a satisfactory figure. The great advantages of natural gas have brought increased business to the city, of which we receive a share of the benefit; and I think it a remarkable circumstance, and speaks well for the vitality of our industry, that amidst this keen competition—cheap oil, a well-equipped arc and incandescent electric light plant, and a natural gas company giving its gas free for lighting purposes—we not only hold our own, but we actually sent out 700,000 feet more gas last month than we sent out the corresponding month of last year. We feel it is an advantage also that our people are being thoroughly educated in the use of gas for lighting, cooking, and heating purposes; and when natural gas fails, as I believe it will do in a few years at most, there will be an unresisting demand for the manufactured article to take its place.

Discussion.

The President—We are much indebted to the authors for these contributions. The papers are before you for discussion.

Mr. H. T. Gerould—When was natural gas introduced in Indianapolis?

Mr. Somerville—Two years ago.

The President—I think Mr. Cowdery's paper answers some questions, asked yesterday by Mr. Lansden, when Mr. Chollar's paper was under discussion.

Mr. Lansden—What Mr. Cowdery says with regard to mixed gases coincides exactly with my experience. I do not find any test that he has made which I have not myself verified.

Mr. Ramsdell—I would like to ask Mr. Cowdery what his system of radiation is—whether through ordinary radiators or through the pipe system.

Mr. Cowdery—Through four lines of 1¼-inch pipe running around the room close to the base-boards.

Mr. Ramsdell—I tried some experiments with the same system exactly, and with just about the same result. I think my figures were 7 cents per thousand for heating.

Mr. Somerville—I would like to ask Mr. Cowdery if he took any unusual precautions to save the heat from going away; or was it, for practical purposes, just the same as anyone would use it for heating water?

Mr. Cowdery—Just the same as a person would use in it the house in an ordinary gas stove for heating water, only I took as good a type of gas burner as I could find. I took no unusual precautions to save the heat.

On motion of Mr. Forstall the thanks of the Association were voted to Messrs. Cowdery and Somerville for their papers.

A Batch of Invitations.

At this point the Secretary read letters, from the Municipal Electric Light and Power Company, and from the Ringen Stove Company, inviting the Association to inspect their respective plants. After a vote of thanks for the invitations had been adopted, Mr. John Dell announced that those interested in the Coze system of inclined retorts could witness a good working specimen of the same in operation at the Howard street works of the Laclede Company, and added that he would be very pleased to explain the system to those who visited the works.

Mr. Eugene Printz, of Zanesville, Ohio, next read his paper, entitled

WROUGHT IRON, CAST IRON OR STEEL—WHICH IS THE BEST MATERIAL FOR STREET MAINS?

In answering this question, are there not many others to be taken into consideration? The particular purpose for which the main is to be used; the kind of soil in which the pipe is to be laid—that is, does the ground contain any chemical combination that might be more detrimental to one kind of pipe than to another; has the pipe in its manufacture been so made as to be able to resist the action of the destructive agents that may be on the ground? Then, again, the cost of the pipe and the figure at which it can be placed in position, and the cost of maintenance thereafter, are serious matters for consideration. Which, if either kind of pipe, will give the least percentage of gas unaccounted for?

Wrought iron mains have some advantages not possessed by cast iron; owing to its greater strength, it will resist heavier internal pressures; less liable to fracture by sudden jars or by the disturbance of its foundation; can be joined together with less expense and greater speed; has fewer joints and can be laid in some situations where it would be almost impossible to lay cast iron; but it has two disadvantages considered serious ones—the first cost of the pipe and the limited life, as claimed by the friends of cast pipe, when compared with cast iron in many kinds of earth.

In making comparisons as to the cost between wrought iron screw-jointed pipe and cast iron pipe, I have figured as to the price by car loads delivered in Ohio. One mile of 6-inch wrought iron pipe would be $3,485. One mile of 6-inch cast iron pipe would cost $1,930, a difference in favor of the cast iron pipe of $1,555 per mile. One mile of 8-

inch wrought iron pipe would cost $5,710. One mile of 8-inch cast iron pipe would cost $2,700, a difference in favor of the cast iron pipe of $3,010 per mile. The labor for digging and refilling trench would be at least 25 per cent. in favor of the wrought iron pipe, as a trench much less in width will answer the purpose, and no bowl or bell holes are required. The labor, lead and yarn necessary to lay and join 8-inch and 6-inch cast iron pipe would be about $400 for the one and $300 for the other per mile, while the labor and paint cement to join a mile of 8-inch and 6-inch wrought iron screw pipe would be about $150 and $120, respectively—making a difference of $250 for the 8-inch, and $108 for the 6-inch, per mile, in favor of the wrought iron pipe.

The labor figures and cost of pipe on the wrought iron pipes are based on the supposition that screw-joints and standard weight pipe are used. If the patent leaded joint with the light weight wrought iron pipe is used the difference in the labor and lead account will be very much increased in favor of the wrought iron pipe over that of the cast iron—there being a saving in lead alone of 2,800 pounds for the 8-inch, and 2,100 pounds for the 6-inch pipe per mile; and as the pipe is so much less in weight, and a less number of joints to be made, it can be handled and laid with less labor and with greater rapidity.

It is claimed by those who advise the use of wrought iron pipe, and they have strong evidence to substantiate their claims, that there is less leakage, in fact a very large percentage less, than when cast iron is used: this we must admit would naturally be the case, owing to the more porous character of cast iron; but why there should be less leakage at the joints, only in proportion as there are fewer of them, we fail to understand; a joint that is gas-tight ought to be as good with one kind of pipe as with another. But it is urged that it is impossible to make a lead joint with cast iron pipe that will remain tight; that with the continual expansion and contraction of the pipe, although the movement may be very slight, will, with the rough surface of the spigot end, soon start the joint to leaking; and that with a lead joint on wrought iron pipe this is not the case, for the reason that while the movement may be greater, the surface of the pipe is smooth—sliding easily back and forth, without tearing or disturbing the joint.

Mains have been made of cast iron ever since the general introduction of gas for illumination (nearly three-quarters of a century), and when examined or removed are found, with the exception of a slight coating on the outside, to be, as far as the texture of the iron is concerned, in as perfect condition as if just placed in the ground. There are, of course, exceptional cases, but not many, where the ground has become impregnated with some foreign matter, which will and does act on and destroy the cast iron in a comparatively short time.

My own experience with cast iron for mains is limited to that of pipe, at present, used at my home. Some of it was placed in position 41 years ago. We are at present, and have been every season for the last 10 years, replacing the old lines with larger ones, and using the old ones again on streets where their size will be sufficient. To be sure, we find many pipes that are imperfect in their construction, but the iron itself is as sound and perfect as when first cast.

We have but very little wrought iron pipe in use for street mains—one short section of 3-inch, about 400 feet long, which has been down 10 years. It formerly did duty to convey gas on a bridge; it was at that time protected from the weather, and kept well painted; last week we had occasion to tap it for a service connection, and we found, to our surprise, after the 10 years' duty, it was in perfect condition.

As a means of comparison in the life of wrought and cast iron (when neither is covered with a protective coating, and is equally exposed to a very severe test), I will cite an actual experience which happened on one of the short streets in our city: On this street was a 2-inch cast iron main, with a number of service connections all three-quarter inch except one (an inch-and-half) which conveyed gas to a machine shop; going south from a certain cross street there was no difficulty whatever; but north from this point we were compelled to renew the service pipes every two or three years. Now, for the cause of this trouble: For a number of years this portion of the street had carried as surface drainage, the sulphur, or commonly called "copperas" water from several coal mines. The street was paved with limestone, the spaces between the stone filled with sand, but not cemented with tar or pitch. The drainage from the coal mines percolated through the sand and saturated the ground, which was composed of a mixture of clay and gravel, in which the 2-inch cast iron main was laid. In 18 years the texture or composition of the pipe was so changed or destroyed that the pipe, on being removed, was so soft that it could be shaved with a common penknife as easily as the plumbago in our lead pencils; there was not strength enough in a 7-foot length to carry its own weight when placed upon supports at the ends. You will notice the life of cast iron pipe as compared with wrought in this instance, after making due allowance for the difference in the thickness of the metal, is as 3½ is to 1.

On another street we have two short lines of 2-inch main,—one a cast iron and the other a wrought. The cast iron has been in 20 years and is in fair condition; the wrought iron has been in only 15 years and will of necessity have to be replaced in a very short time.

In this connection I will quote a few lines received from Mr. Cantine, of the Alliance Gas Light Company, Alliance, Ohio. He writes as follows:

"We had a 4-inch cast iron pipe leading from our main line through the Pennsylvania Railroad Company's yard to supply their ticket office and eating house; and, that after having been laid some 6 or 8 years, we found it leaking badly. This pipe was extra heavy and of sufficient weight to be known as water pipe. The ground in which it was laid was mixed with cinders from locomotive ash pits. The action of the impurities in the cinders had rendered the pipe utterly worthless, it having no more strength than unburned clay. The process of decomposition is or would be much more rapid in wrought iron or steel than with cast metal. The contact of one cinder no larger than a walnut will eventually eat its way through any pipe."

I have called attention to these instances, in a measure, in the first two, to compare the life of the two kinds of pipe under the same circumstances, and in the first and third to show that even cast iron may be readily destroyed when subjected to certain conditions.

Will not the question be asked, Why is it, that one kind of pipe will last so much longer in the same kind of earth than will the other kind of pipe? A gentleman to whom I put this question, suggested: Is it not that cast iron and wrought iron are different in their construction, different in their chemical formation? In cast iron, the particles of iron of which it is composed retain their crystalline or natural shape, and contains a proportion of carbon; these crystals are in nature hard, bright, and in a measure polished, and are more or less coated with graphite, depending greatly on the quality of the iron; all tending to preserve the metal from oxidation. In the manufacture of wrought iron a portion of the carbon is eliminated, rendering the metal softer; the crystal or natural form is broken up; the crystals are elongated or drawn out, presenting a stringy or fibrous appearance through the length of the metal. The graphite coating or protection of the crystals is removed, rendering the pipe more open to the action of the destructive agents.

Again: The question is asked, Why will the same kind of pipe last longer in one formation of earth than in another? Have you not noticed when your pipe, particularly cast iron, was buried in sand for a number of years, that a thin, hard coating impenetrable to almost anything, had formed on the outside of the pipe? This coating forms to a certain thickness; there the decomposition stops. Nature in this case has provided a nearly perfect and perpetual protector. Is not this combination of sand and iron, which is almost like glass in its hard appearance, silicate of iron? And have you not further noticed, that where this formation does exist, there is no escape of gas unless it be at the joints—the coating forming a gas-tight covering.

On the other hand when your pipes of either kind have been buried in white clay, the tendency has been to deteriorate, in many cases, quite rapidly. Can we not account for this in this wise? In nearly all cases white clay veins or banks are overlaid with coal in some form; sulphur, in solution from the coal, saturates the clay, comes in contact with and surrounds the pipe; the sulphur having a strong affinity for iron, combines with it; sulphuret or sulphide of iron is formed and the pipe is destroyed, more or less rapidly, in proportion to the amount of sulphur. This same action takes place where the pipe is exposed to coal cinders, similar to the case referred to in the quotation from Mr. Cantine's letter,—there the free sulphur in the cinder combining with the iron.

Again: If your pipe is laid in ground so situated as to absorb, or in any way to contain matter likely to ferment, near by, or in contact with the pipe, there is great danger; for, during the process of fermentation, carbonic acid is evolved. This acid is particularly destructive, and very persistent in its combination with iron; once it takes hold it never releases its grip until it has accomplished its purpose. An example of the action of carbonic acid on wrought iron is very clearly shown by the rust or pitted spots on the sheets of our gas holder. We notice first a little yellow dust; the carbonic acid of the atmosphere has combined with the iron forming carbonate of iron. This dust, in a very short time is oxidized, gradually becoming more red in color. In the meantime, the carbonic acid has moved on, and is working on the way to new iron, which it will continue to do as long as there is any iron to be found. We have often wondered why it was that after cleaning and painting the sheets of our gasholders, that in a few months we would find indications of rust, and that, too, right under the protective (as we supposed

covering of paint; but the carbonic acid was surely there and you cannot remove it, unless you scrape right down into the clear iron; every particle of rust must be removed before you can hope to be relieved of this troublesome destroyer of iron.

While not exactly germain to the question we have before us, yet bearing in that direction, I have thought it might be of interest to some of our members to examine a section of 6-inch wrought iron pipe which I submit for your inspection. This piece of pipe was in use just 2 years and 7 months as a stand-pipe to convey the gas from the retort to the hydraulic main. You will observe that it is completely used up. In the same gas works there are cast iron stand-pipes that have been in service for over 30 years, and from all appearances are good for another 30 years. I think you will agree with me in the statement that there is one purpose for which it is surely best to use cast iron pipes.

When the question is asked, "Which is the best material for street mains—cast iron or wrought iron?" we would likely answer at once, cast iron. Why? Because we have been accustomed to purchase the same for a great deal less money; it is cheaper, and it will last longer; and then we say again we have to renew our wrought iron services, and we do not the cast iron mains. Have we not overlooked the fact that the wrought iron services are less than one-half the thickness of the cast iron mains; that where we have had occasion to make renewals, the wrought iron had been more exposed than the cast iron. The services mostly gave out at gutter crossings, where the pipe was not of sufficient depth, and was exposed to air, and dampness, and frost. Is it not true that many of us have wrought iron services in use to day, and in good condition, that were connected to our cast iron street mains, when gas was first introduced to our towns, 40, and in some cases, 60 years ago. We know what to expect as to the lasting qualities of cast iron pipe. We know that with cast iron mains the leakage of gas will average as much as 10 per cent. This we gather from the reports received from a majority of the gas companies.

Now, we will see just what is claimed and we may say proven as to the lasting properties of wrought mains; also, as to the leakage where they have been used.

From Mr. J. B. Overton, Virginia City, Nev., we quote as follows:

"I have to say, that the 10-inch lap-welded pipe furnished by you appears to be as good to-day as it was when first put down in 1875. The light 18-inch pipe which I bought of your company in 1876, has been in constant use, and has given no trouble, nor has it cost a cent since laying."

Under date of November 14th, 1882, we have the following:

"Gents—In reply to yours of the 9th inst., inquiring about the lasting quality of wrought iron pipe for gas mains, I would say: We put in some wrought iron main in 1858; before laying it, we coated it with tar and let it dry in the sun; used tar on the threads and couplings freely, mixed with sand. In 1874 we had some of the same mains taken out, being too small to supply the consumption. In all cases the pipe was sound and clean; all we had to do was to re tar it and then re-lay it in other streets. We now have in use over 8 miles of wrought iron pipe from 1¼ to 4 inches in diameter, and all of it giving the best of satisfaction. Our leakage account will compare more than favorably with any other works, and we claim that wrought iron pipe is the cause of it." (Signed, THOMAS BUTTERWORTH, Rockford, Ill.)

The following is a telegram from Mr. O. P. Shaffer, Treasurer Standard Gas Light Company, New York City:

"We find wrought iron gas mains practically stop all leakage; only leaks we have are on cast iron crosses and sleeves; leakage in cast iron lines in this city averages 14 per cent.; ours does not exceed 1 per cent."

Mr. W.W. McCleary, Superintendent Gas Company, Braddock, Pa., writes the following:

"Our whole gas system is composed of the Converse light-lock joint wrought iron pipe. Is giving perfect satisfaction; less than 1 per cent. leakage."

The following extract accompanies the sample pipe from the McKeesport Gas Company:

"I send you a section of 4-inch O. D. line of our special wrought iron gas pipe, which was laid by me in 1875. We took it up in September, 1887, and found it in as perfectly serviceable a condition as when it was put in the ground. I must say it was a surprise to me to find it so perfect. Cast iron could not have made such a record under similar circumstances. I have taken up cast iron pipe from the same soils here, which had not been buried for nearly so long a time, and the result has been just the reverse of this. Our soil is a very severe one, and the showing in this case proves durability of your coated wrought iron pipe." (Signed, W. C. NEEMES, Supt.)

I have here a report from Mr. C. E. Manly, Chemist:

"The following is my brief report relative to a piece of wrought iron taken from a 9-mile line of 22-inch riveted pipe, working under a head of 530 feet, and having been in the ground 13 years at the mines north of San Francisco. Sample submitted by Mr. T. W. Brooks.

"On making my inspection of this piece of iron I find it is in good condition and as perfect as any piece of iron just newly rolled. The iron is smooth and has a uniform gauge of No. 11. I notice there is not a particle of rust to be found adhering to the iron. This state of preservation is undoubtedly due to the protection of prime asphaltum coating. That metallic iron will rust in contact with water, which latter contains free oxygen, air, or carbonic acid gas, nature demonstrates every day; and no matter how perfect the iron may be, yet oxidation will show itself sooner or later upon unprotected iron, especially with cast iron, due to the impurities therein. These impurities amount to 100 per cent. of the bulk of the cast iron, due to the graphite, silicon and sand; and it is therefore possible for the entire iron to be dissolved out whenever galvanic action exists, in patches destructive to cast iron; the result is a mere shell of graphite and silica, representing the original curve and thickness of the pipe. With wrought iron, this peculiarity of galvanic action is unknown, due to its purity and absence of crystallization; but to insure perfect safety, means are taken to prevent any disaster of this kind, defecting even to a small degree the surfaces of wrought iron, by the use of asphaltum or any hard surface impervious to moisture. We have 14 years' experience to substantiate the above statement, and as the iron does not show a sign of blemish after the 14 years' service, I consider it will be found in as good condition 100 years hence as it is today." (Signed by C. E. Manby, Chemist.)

Is it not a serious question, "Which is the best—wrought iron or cast iron for street mains?" The wrought iron costing, in the first place, from 50 to 100 per cent. more than does the cast pipe. (This difference is greatly reduced in proportion as you get further away from the points of manufacture. The freight rates—a very important item—being very much in favor of wrought iron, as the same car will carry many more feet of the light wrought iron than it will of the heavy cast pipe.) The wrought pipe does not cost near so much to lay, and the saving in leakage will in a very short time balance the extra expense for the wrought iron pipe. The most important question appears to be, Will the wrought pipe last? On the other hand, why not have our cast iron pipe, which we think, under ordinary circumstances will last, properly coated with some material that will close the pores and protect the iron beyond a doubt; also, have the spigot end of the pipe turned or ground smooth, so that a permanent and tight joint could be made. This certainly would not add a great deal to the price of the present cheaper pipe, and you would save quite a large percentage on the outlay.

Steel Mains.—Engineers and experts are of the opinion that to weld, or properly join two pieces of steel, requires that blows as with a hammer should be given; that they will not join by being rolled or crushed together, as will wrought iron, for the reason that the fiber is too short; that the two surfaces merely stick together as with a flux, just as two boards are glued together one upon the other.

In welding wrought iron pipe with the machinery constructed for the purpose, the long fibers of the iron are firmly interlaced and joined—the joint or weld being as firm as any other portion of the pipe. I have here a sample of welded steel pipe which I hope you will examine.

Again, it is claimed that steel, being short in the grain, gives a great deal of trouble by fracturing near the joints at the threads. For these two reasons it is not considered advisable to use steel mains.

Converse Joint.—Our worthy Secretary intimated to me that a word in regard to the Converse jointed pipe would likely be of interest. Not knowing anything of it personally, I visited the shops of the manufacturers to learn how it was made, what it was made of, and to see a joint tested under pressure. The joint I saw tested was made in my presence—two short lengths, about 4 feet each, of 6-inch outside diameter pipes (the thickness of the metal was not quite ¼ inch), were joined with the short sleeve used in this style of joint—no yarn or tarred rope was necessary—just simply slide the ends of the pipes in the sleeve, give them a slight turn to tighten the lock, then the usual clay roll, pour in the molten lead, caulk the joint in the usual manner (which appeared to be very easily done, as there was not the old-time yarn cushion); the lead was driven solid against the iron, and did not consume so much time as the ordinary joints for cast iron pipes. After the completion of the joint the open ends of the pipes were closed with bolted blank flanges, the pipe laid loosely on trestles, a force pump with pressure gauge was connected to an opening in one of the pipes, and water forced in; a pressure of 500 pounds to the square inch was raised, and allowed to remain for some time, without a sign of leak at the joint. This was

a thrusting strain of 14,000 pounds to force the pipes asunder. The presssure was then raised to 800 pounds per square inch; one of the pipes at this began to slide out from the sleeve; and the joint to leak slightly. I asked that the pressure be reduced and the lead re-caulked, which was done and the pressure again raised to 300 pounds before a leak was started. Again the pressure was raised to 850 pounds per inch, or a thrusting strain of 22,800 pounds, to part the joint.

During my investigation I learned the pipe was manufactured of the best grade of wrought iron, similar to that used in the manufacture of boiler tubes or flues. After the pipes have been tested for imperfections they are thoroughly coated inside and out by being boiled in a mixture called "kalamein." Kalameining consists in "incorporating upon and into the body of the iron a non-corrosive metal alloy, largely composed of tin." The surface thus formed is not fractured by blows, or by bending the pipe either hot or cold. The sleeve or coupling is made of the toughest and best grade of cast iron, and is boiled in paraffine to close up the minute pores of the iron. The outside of it, as well as the pipe, is then, if desired, coated again with asphaltum. By request, the manufacturers have submitted here for your inspection samples of the pipe and joint.

The Converse jointed pipe is used very extensively by a number of water companies and natural gas companies. Engineers of these companies, by their testimonials, freely given, speak very highly of it as being so well adapted to resist the high pressures and the unusual strains brought upon it by the slips on the mountain sides. They refer to it as giving less trouble from leaky joints than any other pipe they had ever used (not excepting the screw and jointed pipe).

An idea as to how much engineers appreciate the use of wrought iron for mains for water, manufactured and natural gas, oil, compressed air, and other purposes, may be imagined when it is understood that of the Converse jointed pipe alone there was sold in the eight years preceding January, 1890, pipe ranging in sizes from 22 to 24 inch, a total amount of nearly 7,000,000 feet, or nearly 1,300 miles.

The Laclede Gas Light Company, St. Louis, Mo., have, up to this time, placed orders to the amount of 18,000 feet of 12-inch, 12,000 feet of 6-inch, and over 6,000 feet of 4-inch Converse light lock-jointed wrought iron pipe.

The Philadelphia Natural Gas Company say:

"We have used perhaps 75 miles of the Converse joint pipe, and have found it first-class pipe in every respect. The joint is a good one, very easily put together, and after the line is connected the pipe is tight under a pressure of 250 pounds to the square inch. We do not carry this pressure, however, on our line in actual use, but test it up this high. We have just taken up considerable of this pipe from a field abandoned, and relaid it in a new field, and find it is just as good as the day we put it down, and as easily put together. In short, we take pleasure in saying the Converse pipe is all that is claimed for it by the makers." (Signed by T. A. Gillespie, General Superintendent.)

Friction.—From Prof. John C. Trautwine we have this opinion:

"As the Converse joint produces an absolutely smooth interior, reducing friction to a minimum, the increased flow and delivery of gas will be readily appreciated. The cast iron pipes themselves are not cast perfectly straight, or smooth, or of uniform diameter, and irregular swellings produce eddies and retard the flow. Under the most favorable circumstances, therefore, it is expedient to make the diameter of cast iron pipe, even for temporary purposes, sufficient to discharge at least 20 per cent. more than the quantity actually wanted; and still larger allowance should be made in permanent pipes. Natural and manufactured gas mains are usually for permanent lines."

From Prof. Haswell we quote the following:

"The difference in friction between a line of ordinary spigot and bowl-jointed cast iron pipe, and a line of seamless wrought iron pipe, with flush connections alike to the Converse joint, would be fully 25 to 35 per cent."

I have written thus fully in reference to this joint, not because it was my wish to foster or bring to the front any particular patent, but as there appeared to be an especial interest manifested in it, and as far as lay in my power to oblige our worthy Secretary.

Discussion.

The President—This is a most interesting paper, and Mr. Printz will be glad to have you question him.

Mr. Tracy—Once, when I had occasion to lay about half a mile of mains I was undecided whether I should lay cast iron or wrought iron pipe, but after taking up some wrought iron pipe that had been laid in my streets, I made up my mind I would not lay anything but cast iron pipe. The gasfitters and plumbers tell me that in less than four years wrought iron pipe is so completely eaten up that they cannot do anything with it. On the other hand, some cast iron pipe which had been down for 40 years, upon examination was found to be in as good condition as could be desired; but the wrought iron pipe was completely eaten out. This pipe which I took out was taken out on account of being shut up by a drip.

Mr. Miller—I think that steel pipe is somewhat summarily disposed of in Mr. Printz's paper. I have had occasion to put in about four miles of steel service pipe in the past year, using pipe from an inch to an inch and a half. I have also bent some of it hot, and cold, for different purposes, and have given up the use of iron pipe entirely for our services. I find that the steel pipe is softer and cuts nicer. Hence you get a better thread, and can do better work with it. I have had no trouble with that as I have had sometimes with wrought iron pipe.

Mr. Forstall—Our experience with steel pipe is much the same as that of Mr. Miller. We have given up the use of wrought iron pipe almost entirely for services in sizes under two inches. All our pipes, up to two inches, are put in of steel. I find it cuts a better thread, makes a better joint, and does not corrode as fast. There has been no trouble from splitting.

Mr. Thomas—One statement in Mr. Printz's paper ought to be explained. He says:

"The following is a telegram from Mr. O. P. Shaffer, Treasurer, Standard Gas Light Company, New York city:

"We find wrought iron gas mains practically stop all leakage. Only leaks we have are on cast iron crosses and sleeves; leakage in cast iron lines in this city averages 14 per cent.; ours does not exceed 1 per cent."

I have always contended that the term "leakage," as usually employed, is a misnomer. It ought to be called unaccounted-for gas. There has been a great hue and cry in New York city of late, especially in the sections in which the subways have been laid, about gas escapes and gas explosions. It is claimed that the subways are little else than gasholders, and the subway builders and controllers claim to be at a loss for the reason of the presence of the gas in their oddly-built construction. Independent authority could easily explain its presence. The carelessness of the subways workmen, when "picking around" the gas mains, accounts for the leakage and escapes. Mr. Shaffer admits there has been a great deal of leakage from the crosses and sleeves of the Standard Company. The fact that there is such a leakage is evident to anybody who has ever been in New York city. Let me say again, in discussing this question of leakage in New York city, I have always claimed, as I claim now, that with pipe well laid the actual leakage therefrom cannot exceed three-quarters and possibly not more than one-half of 1 per cent. I think the total average loss, between generating house and consumers' burners, in New York city, does not amount to 14 per cent., and the unaccounted for gas can be practically traced so as to bring the main leakage down to less than 1 per cent. The Standard Company have been about 2 or 3 years putting their wrought iron pipe down, and I have never seen any place uncovered, where they had put their pipe down, that I could not smell the escaping gas. All the companies suffer alike in that respect. The upper part of the city is underlaid with rock formation, and in putting sewers through the streets (gas mains have frequently been laid in this section before the sewers were put down, and house drain connections are being constantly made) the blasters pay no attention to gas services or mains. Of course, this causes a great deal of loss. With the best quality cast iron pipes, in works that I have managed, we kept our leakage down to about 6 per cent.; and about 1 per cent. of that was chargeable to over-consumption in the street lamps. We uncovered cast iron pipes that had been in good ground for 30 years, only to find them sound and serviceable. Again, as stated by Mr. Printz, in made ground, or in low spots which had been filled up with coal cinders, coal lime, etc., the pipe, which looked perfectly good in the trench, could be cut through with a jack-knife. Our wrought iron services had to be renewed about every seven years. In my experience, in uncovering pipe that had been laid by my predecessors, I found they had used small pieces of wrought iron pipe, to make what we term a "spring," in the top of the main, and I invariably found that they would leak by reason of stretching of the iron. I adopted what I termed the "brass spring," made with a nipple to screw into the main and a socket for the service pipe. After they had been in use for 20 years, and changes had to be made, they have been removed and used in other places. I suppose if in New York the pipe was permitted to rest in the ground as it ought, the main leakage all over the city would not exceed one-half to three-quarters of 1 per cent. Gas was introduced into New York city about the year 1824. It has been claimed that the leakage has amounted to about 25 per cent., and that from 1824 up to the present time, that leakage has been stored in the

ground. In laying the subways they put in a bed of cement then place the pipe, next put in another bed of cement, then lay another layer of pipe —they lay three or four layers of pipe and of cement together. Then the pipes are led into manholes, which are built of cement and brick, and made perfectly tight, and there they seal them up as they would seal a preserve jar, yet you cannot go along the street at night without noticing the escape of gas from them.

Mr. J. B. Howard—Some 5 years ago we had occasion to renew our mains for about three-quarters of a mile. The pipes were mostly 6 inch and partly 4-inch. We replaced them with 10 inch. The pipes had been in the ground for 34 years. In looking at the services as they were taken out I noticed that in the black loamy soil, although the pipe had been laid for 34 years, it was still just as shiny in appearance as when first laid, with no deterioration whatever. In sandy soil, mixed with clay, the deterioration was somewhat greater, and in soil that was of pure sand we found the deterioration in some places to be considerable In fact it was really a wonder how the services had remained tight; but they had. The pipe was coated over with quite a considerable substance of sand, which had become hardened at certain portions of the pipe length. When we knocked that off we found holes in the pipe at the particular spot where the hard substance had collected. We have some pipe in other parts of the city that has been laid over 30 years, and which I have had occasion to tap once in a while—it is a 2-inch wrought iron pipe, and lays on hills where the pressure is great. I have found on tapping it, to put in ¾-inch connections, that it is just as sound to day as when it was laid. It is of course somewhat discolored, but there does not seem to be any deterioration. This, I think, is due entirely to the peculiar nature of the soil. As to the durability of wrought iron pipe, I think that depends altogether upon the locality where it is laid.

Mr. Egner—I am not authorized to speak for Mr. McMillin (some of you may be pleased to hear that he has arrived safely on the other side of the Atlantic), but I will say when we undertook to readjust our mains, Mr. McMillin (who is the President of the Company, and an able gas engineer, as you all know) called his heads of departments in consultation and he remarked that he would not lay any cast iron pipe over certain sizes. We were about to lay 3½ miles of main from one of the works to the station, to be used just for pumping gas from the works to that station. We decided to try wrought iron pipe. We have laid most of that now. I know that after a little more than a mile had been laid we put the pressure on this pipe with a Westinghouse air pump, up to about 10 pounds per square inch, in the evening, and let it remain so until the next morning, and it did not seem to have leaked any. As to the relative cost and durability I can only speak from hearsay; but I know that Mr. McMillin seems favorably impressed with it, and has determined that we shall not lay any more cast iron pipe of less than certain sizes. I simply desire to tell you what we have done, and why we have done it, and what we know about it. I cannot speak about the durability, nor can I say anything about the cost just now; but I can say that what we did lay was remarkably tight.

Mr. Ramsdell—On that same topic I would say I was in St. Louis recently when this subject came up, and Mr. McMillin made the same remark to me that he made to Mr. Egner. He also stated recently in Ironton, Ohio, he saw some wrought iron pipe taken out which had been laid 17 years before, and that the pipe was in an almost perfect condition. I got an impression from what he said about it that that had something to do with his decision.

Mr. Lansden—I may say, for the benefit of those who may want to test this question, that sixteen years ago I acted as engineer in construction of the works at Chippewa Falls, Wisconsin, and that we laid wrought iron pipes in sandy soil. I know nothing about how they have lasted, but those desiring information can ascertain by writing to the works. I laid wrought iron pipe entirely.

Mr. Tracy—I would like to ask Mr. Printz if, after looking at that pipe, he would advise me to lay half a mile of 3-inch wrought iron pipe.

Mr. Printz—I would not advise you to lay 3-inch wrought iron pipe unless it was protected from the impurities in the soil. You certainly have soil there of a nature that would be destructive to wrought iron pipe.

Mr. Tracy—My specimen example was not taken at one special place, but from different parts of the city. I find it on the hills as well as in the low places; and my services I find are in the same condition. I am protecting my services with a coating of two-thirds tar and one-third naphtha, mixed together. I paint them over with that, but whether it will eventually preserve them or not I do not know.

Mr. Odiorne—A great deal of leakage is attributable to the joints. I use lead joints, and find that they are perfectly tight. If there is too great a strain on the pipe it will break square off before the joint will give. I think if Mr. Tracy is obliged to use cast iron pipe, it would be a good idea to investigate the cement joints.

Mr. Tracy—I have used cement joints for years. I use four parts of cement to one of lead—I use one of lead for expansion—and never have any trouble with the joints.

Mr. Scofield—Some years ago I adopted the plan of laying my pipe during hot weather, in the summer, and coating them with coal tar, and I find that it makes a thorough coating, and is a real protection. I have taken up pipe which has been down for 12 years, and I find the coating as perfect as when it was put down.

Mr. Printz—I think our President has had some experience with the use of wrought iron pipes. I notice he has coated wrought iron pipe with coal tar, heating the pipe by passing steam through it, and then coating with tar. I saw his services put down in that way.

Mr. Somerville—I think you will remember that in Cincinnati all the stand-pipes were of wrought iron; and anyone here who is connected with that works would oblige me by telling how the stand-pipes have stood. I have been laying wrought iron pipes for 20 years, and they are still just as good as new. I do not see why stand-pipes should be affected in that manner by crude gases, for the same crude gases have to go through the hydraulic mains as well as through the stand-pipes and through the scrubbers; and yet you know that the scrubbers last as long as most of us wish them to.

Mr. Forstall—I cannot give Mr. Somerville any information about Cincinnati, but I can say that in Chicago we have wrought iron stand-pipes that have been in use for 6 years; and the last time they were taken down, when we reset the benches, they were apparently as good as new. We have used the same stand-pipes right straight ahead, and have not had to renew any of them.

Mr. Lansden—I will say that the Company I am connected with tried wrought iron stand-pipes for several years. We had a good deal of trouble immediately at the mouthpiece. Five or ten per cent. of them would have holes formed within 18 or 20 inches of the mouthpiece. We are now putting in cast iron entirely whenever one of them gives out.

On motion of Mr. Tracy the thanks of the Association were voted to Mr. Printz for his excellent paper.

Appointing the Special Committees.

The President—I desire to announce the appointment of the following special committees:

Committee of Arrangements, Louisville Meeting.—Messrs. A. H. Barret, Jas. Somerville and Geo. H. Wells.

Committee on Place of Meeting, 1892.—Messrs. Geo. G. Ramsdell, J. B. Howard and Irvin Butterworth.

Votes of Thanks.

The President having announced that the regular business order had been finished, Mr. Lansden moved that a hearty vote of thanks be passed to the President for the able manner in which he had directed the meeting. The motion was seconded by Mr. Tracy, put by the Secretary, and adopted unanimously amid great applause.

In reply to the compliment, President Faben said: Gentlemen, I can simply say that I thank you. It was with great misgiving that I attempted the task. If my efforts have pleased you I feel more than rewarded by the happy manner in which you have recognized them.

Mr. J. B. Howard—If we were to leave this room without thanking our worthy Secretary we would be very remiss. I, therefore, move a vote of thanks to our worthy Secretary for his indefatigable attention to his duties.

The resolution was adopted by rising vote, and Secretary Littleton responded in his usual clever fashion.

Report of Committee on Resolutions.

The Secretary read the following report from the Committee on Resolutions:

Mr. President and Gentlemen of the Association: Referring to the programme (which, by the way, is in itself a work of art), your Committee find the names of the Committee of Arrangements, also the names of the Reception Committee—we will not undertake here to enumerate the names of the committees, but will quote the concluding sentences of the programme, which are as follows: "The various entertainments are given with the compliments of the above named gentlemen and the concerns which they represent." Those of us who have been in St. Louis on occasions similar to this before, know something of the hospitality and entertainment that can be developed here. The programme and the names of the committees would lead to the belief that the old spirit still lives, and that this gathering of the Western Gas Association will have occasion, as in former times, to carry to their homes many pleasant mem-

ories of the 13th annual at St. Louis. We, therefore, propose that the hearty thanks of this Association be tendered to the Committees of Arrangements and Reception and the concerns which they represent.

EDWARD LINDSLEY,
WALTON CLARK.

On motion of Mr. Jenkins the thanks of the Association were voted to the Committees of Arrangements and Reception, as proposed in the report.

The convention then adjourned.

Modern Measurements.

Our English contemporary *Invention* remarks that the progress of measurements in modern times was aptly illustrated in an address recently delivered before the Engineers' Society of Western Pennsylvania, as reported by the secretary of that society. Progress is to-day, he said, written upon every page of the world's record, and particularly in the realms of science is it making its unmistakable mark, from thence extending outward to the vast range of correlated studies that go to make up the sum of human knowledge and economies. In astronomy and astronomical engineering, in physics and chemistry, in civil and mining engineering, in meteorology and in metrology and in mechanics, to say nothing of many other branches of science, do we find progress as the watchword and the theme that excites and moves the human brain to grander and better achievements. The day has forever passed when we are willing to say or believe that "three barleycorns make one inch." Nor is the advanced mechanic of to-day satisfied with his boxwood rule, graduated to thirty-seconds of an inch, save for the coarsest approximate measurements; but he must have his standard graduated to $\frac{1}{100}$ inch for his coarse measures, and his micrometer gauges reading to $\frac{1}{1000}$ for ordinary work. Even in our iron and steel works, the old-time wire gauge, that for a long time held its own, has been displaced by the micrometer gauge of infinitely greater accuracy.

Prof. Wm. A. Rogers has shown that many of our modern mechanics can caliper to $\frac{1}{30000}$ of an inch. These, however, are coarse, rough measures when compared with others that may be mentioned. In the domain of astronomical measurements great progress has been made of late years; by the use of refined instrumental means, as well as the many methods devised for the elimination of instrumental errors, divisions of the meridian circle have been brought to astonishing accuracy.

The various enlightened and civilized nations have standards of weight and measure that have slowly been evolved from the cubit, the span, the finger length and the barleycorn, if you please.

Nations have their standards. On what are they based? The French meter is presumed to be $\frac{1}{10000000}$ of the earth's quadrant, the English yard evolved from the barleycorn, etc., but the measurements of precision in our day demand an indestructible, absolute and unalterable basis for our standards, so that if they all be destroyed the original is still available. Prof. Michelson has chosen a wave length of sodium light as the basis for a new standard, a something that will remain forever of the same absolute linear value. Now a wave length of sodium light is, roughly speaking, about $\frac{1}{47000}$ of an inch long. Now, as this is an appreciable figure, it is evident that any method proposed to measure its absolute value must be of the highest accuracy. The method devised by Prof. Michelson in the refractometer has certainly brought the work to marvellous perfection. He has shown that the error was not greater than 1 part in 2,000,000, and possibly would be made not greater than 1 in 10,000,000. Gentlemen, can you appreciate such a quantity? Yet here is a physicist, with a high ideal of perfection, taking the pulsations that are sent earthward by the sun, and by methods within the reach of human skill, actually recording them upon a standard bar immersed in a freezing mixture, and giving us a universal standard based upon the absolute value of a wave length of light.

We have to thank Sellers, Bement, Warner, and Swasey and others, for their valuable contributions of metrology, and their standards of various kinds that have contributed so much to advance the mechanics in this country. The standard measuring devices made by Brown and Sharpe have become a power for accurate work. The standard gauges of the Pratt & Whitney Company now find an honored place in all high-class machine shops; and our American machinists are greatly indebted to the labors of Prof. W. A. Rogers and Mr. George M. Bond, who designed and carried into execution that wonderful instrument of precision called the Rogers-Bond comparator, from which has emanated many standard tools, and has assisted so largely in the introduction of interchangeable parts in American machinery. It is true that human brains must have a limit to their capabilities; but where shall we place that limit? Watt gave us the horse power as the unit of measurement, Joule gave us the better one of the foot-pound unit; King Henry's arm may have served for the long measure, and the barleycorn for the short measure, but the meter and the micron are infinitely superior; yet we still hope for better standards, and are now reaching out for waves of radiant energy from which to make them, and which shall remain as constant as the universe, "whose builder and maker is God."

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, June 10, 1890.

The Gas Institute.—The Labor Question.—Sulphur Recovery.—Improvements in Sulphate Apparatus.

The final programme for the Gas Institute meeting next week has just been issued, and affords even greater promise for the ensuing meeting, than I ventured to indicate two months ago. The list of papers comprises eleven, including almost every subject of current issue to the gas industry. Three papers deal with gasholder construction, one with stoking machinery, one with the labor question, one with inclined retorts, and the remainder with sulphate of ammonia, the extension of the gas companies responsibility to fittings beyond the meter, oxygenated oil gas, illuminating water gas, and the supply of electricity by gas companies, respectively. The proper discussion of all these subjects will fully and profitably occupy the time at disposal. The public part of the proceedings is on an equally substantial scale, comprising a smoking concert, a musical *soiree* with a dance afterwards, a visit to a rose show, an open air promenade concert and a steam boat trip around the Isle of Wight. Altogether the programme is the best that has ever been set before the members of the Institute, and reflects the greatest credit on all concerned in getting it together, and especially on the President, Mr. Geo. Garnett, who has had the lion's share of the work.

Amongst the matters treated in the report of the Council to be presented at the meeting, will be an acknowledgement of the kindness and courtesy extended to a party of some 120 members of the Gas Institute, by the French Gas Engineers, on the occasion of their visit to Paris at the close of last year's meeting. The Council will also give their reasons for wishing to incorporate the Institute as a limited company under the Companies' Acts. An extraordinary meeting will be held at the close of the general business, for the consideration of this question. Of the members removed by death during the year, special reference will be made to the late Mr. G. W. Stevenson, and the late Mr. Lewis Thompson. It is proposed that the Birmingham medal shall be awarded to Mr. Thos. Newbigging. The Institute now numbers 649 members of all classes.

The labor question has again come to the front in London, and this time it is on the North side of the Thames. In this case, also, the policy of the leaders of the laborers and stokers Union has been to promote distrust, antagonism and insubordination on the part of the men towards their employers. Mr. John West had fitted up a retort house at Beckton with his patent stoking machinery, and agreed with the Gaslight and Coke Company to work it for a time under his own superintendence. Having arranged all in readiness for a start, and engaged a gang of stokers, he was met by the refusal of the men to carry out their engagement. Acting under the advice of their Union, at the hour for commencing work, and not before, the men announced that they would not work unless paid 5d. a day more than the sum agreed upon. The object of this advice is not very apparent, seeing that the only difference it made to Mr. West was that it hindered him for an hour or two. There were plenty of men about who lost their regular employment at the strike at the South Metropolitan last winter, and were only too glad to get into work again. One of the leaders of the Union, in commenting upon the defeats experienced in Manchester and London last year, stated that the next strike would be a momentary one, and that the men would throw down their tools without notice, and take the consequences of breaking their engagements. If this was intended as a trial of such an illegal mode of action, the result must be anything but satisfactory to the Union, as neither the members nor the policy of the Union has been benefited in the least. Mr. West is now carrying on his operations satisfactorily with non-union men, but he has found it necessary to provide special accommodation for them on the grounds, and to have extra police protection. The necessity for this arises, however, more on account of the personal feelings of individual members of the Union, rather than for any organized plan of individualism; though it must be said that a Union that would not hesitate to instruct its members to defy the law in one way, is not likely to be scrupulous about breaking it in another, if it suited the purpose in view to do so.

The Union, to be consistent, ought to welcome and support anything in the way of retort house machinery, seeing that when appealing to public sympathy last year, a great deal was said about the sweltering atmosphere of the retort house, the necessity for working like madmen in order to escape the raging fury of the flames, and the work being so exhausting as to make a man old at the age of 40. They ought therefore, to publicly recognize Mr, West as a benefactor in trying to devise a practical remedy for such a wretched state of affairs. But actions speaking louder than words, and although they make great protestations about not being antagonistic to machinery, it is quite evident that they do not intend to facilitate its introduction in any way.

This matter, however, is only a little side skirmish. The main point of dispute is the fact that the Directors of the Gas Light and Coke Company are endeavoring to make such arrangements as shall preserve them from the misfortune that befell their neighbors last year, and which, besides costing some £50,000 or more, involved a great deal of inconvenience to the consumers. In this they are to be commended, as recognizing the irresponsibilities both to the consumers and to the shareholders, and seeking to meet them. But this, of course, does not suit the Union, who wish to get a grip upon every board of gas directors in the kingdom. Once possessed of such power they would not hesitate to use it on any and every possible occasion, and no body of employers would be safe for two days together. The Directors propose that every workman in their employ shall sign a monthly agreement. The first clause specifies that notice to terminate the engagement must be given on the same days of the month as that on which the agreement commences, in writing. The second provides for the summary dismissal of the workman without notice in case of drunkeness, neglect of duty, insubordination, or other misconduct. According to the third, the workman agrees to observe all instructions, rules and regulations issued under the authority of the Company; and the fourth agrees that duties shall be performed in a proper manner, at the customary rates of pay. The men are to be offered an opportunity, through their representatives, of discussing the terms of this agreement, and while not objecting to meet the men by modifications in details, the Directors must hold firmly to the main principles of the agreement as absolutely necessary to the proper carrying out of the undertaking.

The sulphur recovery process, by which is meant the precipitation of solid flowers of sulphur from any gas that is rich in sulphureted hydrogen, is becoming quite a recognized thing. It has already been adopted by the leading alkali manufacturers, and is rapidly making its way in large gas works, as a means of treating the waste gases given off during the manufacture of sulphate of ammonia. The general plan in small works is to pass the gases coming off from the saturator through an oxide purifier, whereby the sulphureted hydrogen is absorbed, and in a sense utilized, since the sulphur can be extracted from the spent oxide. Turned to account in this way, however, the cost of conveying the material to the chemical works, and other charges, leaves very little profit to come in from this source to the gas undertaking; and therefore the Claus kiln and settling chamber are considered to be preferable. In Lancashire, especially, the erection of sulphur recovery apparatus is proceeding with energy, and at a gas works in the Midlands, nearly 1 cwt. of sulphur is obtained for each ton of sulphate made. This represents 1¼ pounds of sulphur from each ton of coal. Various difficulties, that at first proved a great hindrance to the adoption of the Claus apparatus, are gradually being done away with, so that the next few years will see its general introduction, for it is simple, and when properly under control, automatic in its operations. A proper quantity of air is mixed with the waste gases, according to the proportion of sulphureted hydrogen present, and the mixture is passed into the kiln, which is simply a small chamber about a foot or so each way. Here the sulphureted hydrogen is decomposed with separation of the sulphur in the solid form. The latter is deposited in large condensing chambers provided for the purpose, from which it can be removed at convenient intervals.

The last few years have also seen considerable improvements in the apparatus for manufacturing sulphate of ammonia in gas works. The plain boiler, with which intermittent work only is possible, since it must be emptied when exhausted, and fitted with a fresh charge of liquor before a fresh start can be made, is gradually giving place to improved forms of still, several makes of which are in the market. In one respect these new stills all agree, and that is in being worked continuously. The liquor flows in without cessation, so long as the apparatus is at work; it may be for several weeks if desired. The whole process thus proceeds with perfect regularity. There is no need for the cumbrous overhead tank, large enough to hold the fresh charge for the boiler, or for a cooling tank to receive the exhausted charge. The liquor flowing in regularly, can be pumped direct from the store well as wanted, and as the effluent passes off with equal regularity, a large stock of it at boiling heat does not accumulate, and it can be readily disposed of as fast as it is made. Recently an improved automatic discharger has been introduced, by means of which the sulphate is raised from the saturator to the draining board.

If this invention will work properly it is likely to be valuable, as at present one man's time is almost entirely occupied in fishing the sulphate out as fast as it is formed with a perforated bowl fixed to a handle; and the continual rubbing and scraping of the bowl on the bottom of the saturator wears out that part much sooner than would otherwise be the case. Steam has almost entirely replaced the open furnace as a means of heating up the liquor for distillation. Sulphate apparatus is also being introduced into the smaller sizes of gas works with advantage, and it is now no uncommon thing for a works carbonizing only 400 or 500 tons of coal a year to have its little sulphate apparatus. Under these circumstances 4 or 5 tons of sulphate can be made per annum at a profit of at least $20 per ton, whereas formerly the liquor realized practically nothing.

Assay of Coal.

A contemporary, in a sensibly-prepared article on this subject, says that those who are prospecting after coal often have difficulty in determining to what class their finds belong. The principal varieties of coal are as follows:

Anthracite or hard coal—hardness, 2 to 2.5; specific gravity = 1.32 to 1.70. Contains volatile matter after drying, 3 to 6 per cent. Contains carbon 80 to 95 per cent. It has a high luster and burns without flame, as it contains little or no bitumen. It is totally devoid of impressions of plants, and is, geologically speaking, the oldest of all kinds of fossil charcoal, and is regarded as the last stage of carbonization. It yields from 1 to 7 per cent. of ash, but 3 per cent. may be called the average.

Brown coal, or lignite, much of which is found in California, contains from 57 to 70 per cent. of carbon, and represents the first stage of carbonization, being a coal of comparatively recent formation. It is composed of fossil plants more or less mineralized, and when burnt evolves much smoke and affords a dull flame, generally yielding a large quantity of ash. It contains from 2 to 19 per cent. ash.

Caking coal is a bituminous coal, which softens and becomes pasty in the fire, and after the heat has become continued for a time, the volatile ingredients are driven off, and a grayish-black fretted mass is left. The coke obtained from this coal varies from 50 to 85 per cent.

Non-caking coal resembles the above in its external character, but burns freely without softening or showing any appearance of incipient fusion.

Cannel coal is a bituminous coal which generally cakes. It is compact, with little or no luster, and has a dull black or grayish-black color. On distillation it affords, after drying, 40 to 66 per cent. of volatile matter. When held in the flame of a candle it easily ignites, burning with a steady, bright flame. It is used extensively for making illuminating gas, of which it affords a better quality than any other species of coal.

It is well to know that no very extensive apparatus is required to determine many points about coal. It can be examined and its commercial properties determined by the blow-pipe with great accuracy. Mr. Geo. Attwood (eldest son of Melville Attwood, of San Francisco), in his work on "Practical Blowpipe Assaying," gives the following methods of determining the character and properties of coal, by means of the blowpipe:

The assay is divided into five heads.

1st. The moisture determination.

Select from the mass of coal to be examined a few lumps representing as nearly as possible the average quality. Crush them up in the agate mortar into small pieces about the size of a mustard seed.

Weigh out 5 grains, place in a small porcelain dish, and dry at a gentle heat over the spirit lamp. Hard coals sometimes fly when heated, so it is best to cover the dish with a watch-glass while heating. After about 5 minutes, remove the assay and weigh; then repeat the heating and again weigh. As soon as the weights agree the assay is ready to be converted into coke. Plattner states that the percentage of moisture is lowest in anthracite; in bituminous coals it is usually 3 to 4 per cent., seldom 6 to 7, and reaches its maximum in lignite and brown coals, which contain 20 per cent. and sometimes more.

2d. Determination of the coke production.

Take the dried coal and remove to a clay or platinum crucible, and cover with a small roasting clay dish or platinum cup. Place the crucible on a triangle of platinum wire on the blowpipe stand under the flame, using alcohol, and cover it with a small sheet iron funnel (the

same that is used in roasting copper ores). The heat is continued until all the volatile gas has escaped, when the assay generally will appear to possess a fused, porous appearance, and to have a metallic luster.

The coke so made is now removed and weighed. It should be weighed quickly, as coke absorbs moisture from the air rapidly. The coking takes about 10 minutes, and the crucible should not be allowed to get beyond a red heat.

3d. The estimation of the amount of ash.

After the percentage of coke has been determined, remove the assay to a small clay or platinum capsule, and, without using a cover, again heat over the lamp—this time to a bright red color—until all the carbon has been consumed. The operation is much facilitated by occasionally stirring the assay with a piece of platinum wire, also by applying the blowpipe flame to the bottom of the cup when the assay is nearly finished.

If alcohol cannot be obtained, the assay for coke and ash can be conducted in the charcoal furnace by using the blowpipe flame, as in the copper assay, and if the ash amounts to more than 5 per cent., the value of the coal is much dimished. If the ash presents a brown, red, or gray color, sesquioxide of iron has been formed by the oxidation of the pyrites in the coal.

4th. Determination of the absolute heating power by Berthier's process.

Take an average sample of the coal and crush it up to the finest powder. Weigh out 0.3 grain of the coal dust and mix it with 12 grains of oxychloride of lead, and after placing the mixture in the crucible cover it with an additional 12 grains of oxychloride of lead.

Oxychloride of lead fuses more readily than litharge; therefore, owing to the large quantity of material which must be brought into a state of fusion in this determination, it is employed instead of litharge.

The assay is next covered with a little powdered glass, also with a few spoonfuls of borax glass. A clay cup is placed over the crucible, and the assay is then fused in the charcoal furnace in a similar manner to the silver assay when litharge is used.

About 7 or 8 minutes suffice to melt the assay, and the lead button produced by the carbon in the coal acting on the lead oxychloride will be found lying upon the bottom of the crucible when the assay is cool and the crucible is broken.

The weight of the button, when cleaned from the slag, divided by 20, gives the quantity of lead that one part of the fuel under examination can reduce; and since one part of carbon reduces 34 parts of lead, the heating power of the fuel may be easily ascertained. The amount of lead reduced by one part of coal varies with the different pit coals between 21 and 32 parts, with the lignites between 16 and 25 parts. In making this assay the heat must be applied at first very gradually, and afterward increased to a bright redness.

Dr. Ure's experiments, published in the "Supplement to the Dictionary of Arts, Mines, and Manufactures," have appeared to be unsatisfactory in regard to the accuracy of Berthier's method. Mitchell, however, has found the method correct, and the author has found it equally so. The lead oxychloride should always be pure.

5th. Estimation of sulphur in a sample of coal.

Sulphur generally exists in coal as a sulphide of iron, and as the presence of more than 2 per cent. of sulphur depreciates the market value of coal, owing to its destroying the iron boilers and grates under and over which the coal is consumed, is always an important part of the examination of coal to ascertain the quanity present.

Mitchell, in his "Manual of Practical Assaying," recommends the following process:

Take one part of the finely pulverized coal and mix with 7 to 8 parts of niter, and 16 parts of common salt, and 4 parts of carbonate of potash, all of which must be perfectly pure. The mixture is then placed in a platinum crucible and gently heated at a certain temperature; the whole ignites and burns quietly. The heat is then increased until the mass is fused: the operation is finished when the mass is white. It must, when cold, be dissolved in water, the solution slightly acidulated by means of hydrochloric acid, and chloride of barium added to it as long as a white precipitate forms. This precipitate is sulphate of baryta, which must be collected on a filter, washed, dried, ignited, the filter burnt away, and the remaining sulphate of baryta weighed; every 116 parts of it indicate 16 of sulphur.

The above described methods of examining coal are all that are required for commercial purposes. The assay may be carried on still further by estimating the iron oxide contained in the ash. The ash can also be examined qualitatively for silica, lime, soda and potash.

THE proprietors of the Ilion and Mohawk (N. Y.) Gas Company have commenced work on their proposed electric lighting annex.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE charter of the Hempstead (L. I.) Gas Light Company has been renewed for 30 years, and a special meeting of the shareholders will be held on the 14th prox., the object of the same being to vote on a proposition to increase the capital stock to $25,000. It is likely that important plant betterments will be arranged for at Hempstead this season.

Mr. W. H. HAYDEN has resigned the Superintendency of the Fishkill (N. Y.) Gas Company's plant in order to accept the position of Manager and Superintendent of the works at Schenectady, N. Y.

PRESIDENT D. T. ROOTS, of the P. H. & F. M. Roots Company, of Connersville, Ind., writing under date of June 19th, says: "We are glad to report that our exhauster business is beginning to look up. Our business in foundry blowers, rotary pumps, forges, etc., has been very good at all times, but at the beginning of the year our exhauster trade was not what we expected. We now look for a good trade during the rest of the season, as inquiries are very much better than at any time of the year. Below we give some of our recent orders: Wheeling (West Va.) Gas Light Company, one exhauster and engine combined on same bed-plate, with gas and bye-pass valves, pipe fittings, governor, etc., capacity, 1,500,000 cubic feet per day; Florence (Ala.) Gas Company, one exhauster (valves, fittings and arrangement same as at Wheeling), capacity, 300,000 cubic feet per day; Shreveport (La.) Gas and Electric Light Company (same as above) capacity, 160,000 cubic feet per day; Chillicothe (O.) Gas Company, one exhauster (as before), 160,000 cubic feet per day; Galesburg (Ills.) Gas Company, one exhauster and engine combined, capacity, 300,000 cubic feet per day; Portsmouth (O.) Gas Company, one exhauster, capacity, 160,000 cubic feet per day; Brunswick (Ga.) Gas Company, one exhauster and engine combined, capacity, 100,000 cubic feet per day; Macon (Ga.) Gas Light Company, one exhauster, capacity, 675,000 cubic feet per day; Litchfield (Ills.) Gas Company, one exhauster, capacity, 160,000 cubic feet per day; Fort Worth (Texas) Gas Company—order given by Bouton Foundry Company, of Chicago—one exhauster, etc., capacity, 675,000 cubic feet per day." That certainly looks like business.

ON and after July 1st the Providence (R. I.) Gas Company will sell gas at the rate of $1.30 per 1,000 cubic feet. At least so we have been informed by Treasurer A. B. Slater, who is pretty good authority on such matters.

THE holder tank of the Metropolitan Gas Light Company, of Elizabeth, N. J., was to have been finished last week. The people in interest claim that the backward state of the storage construction is all that prevented them from supplying gas before this date.

MESSRS. J. M. CRITCHLOW, Edwin Fuller and F. W. Perkins, as Liquidating Trustees of the American Gas Improvement Company, through their attorney, Mr. D. F. Patterson, 96 Diamond street, Pittsburgh, Pa., have published the following notice of dissolution: "Notice is hereby given that the American Gas Improvement Company, Limited, a partnership association organized under the Act of Assembly of June 2, 1874, and its supplements, at a regular meeting of its members, at which all its shareholders were present, resolved by unanimous vote to dissolve said association, and elected the undersigned Liquidating Trustees to settle its affairs. All persons indebted to said association will please make immediate payment, and all persons having claims against the same will please present them to the undersigned, who will proceed at once to settle its affairs and distribute its assets under the direction of the Court of Common Pleas, No. 1, of Allegheny county."

THE "Chicago capitalists" in control of a certain fuel gas process, acting in concert with "Asheville (N. C.) capitalists," are said to have organized in Asheville the North Carolina Fuel Gas Company, with a capital of $50,000. It is said they intend to construct a fuel gas plant at Asheville, which proposition is eminently absurd.

A CORRESPONDENT at Albany, N. Y., writing under date of June 23, says: "I note your reference to the proposed winding up of the affairs of the Troy (N. Y.) Electric Light Company, and forward you the following particulars concerning the same: On the application of Mr. Anthony N. Brady, of Albany, and Chas. E. Davenport, of Troy, a majority of the Trustees of the Troy Electric Light Company, Justice Fursman has granted an order for all persons interested in the corporation to show cause before R. C. Jennyss, Referee, at the office of Smith & Parmenter, September 19, why the corporation should not be dissolved.

Parmenter and Smith are attorneys for the petitioner, and the moving affidavits made by Messrs. Brady and Davenport allege that the corporation is insolvent and unable to pay its debts. The assets of the Company are given at $165,666.67, inclusive of $32,000 in real estate, $31,920 in machinery and tools, and $79,980 in electric dynamos, wires and other apparatus. The liabilities are given at $346,284.38, and this includes the following indebtedness: Travelers National Bank, New York, $5,000; Union Bank, Troy, $21,000; National Bank, $18,000; Central Bank, $15,000; D. Powers & Sons, $18,000; Troy City Bank, $10,000; National Park Bank, New York, $20,000; Thomson Houston Electric Company, $7,500 1st mortgage bonds, $57,000 2d mortgage, and $30,000 mortgage on real estate, with $9,000 interest. The stockholders of the Company and the amount of stock are given as follows: E. Murphy, Jr., $1,000; E. W. Hydorn, $4,000; J. Bartlett Hydorn, $2,000; John E. Healey, $2,000; A. N. Brady, $104,200; John B. Powell, $20,200; G. Robertson, Jr.. $2,000; M. R. Mosher, $2,600; M. A. Tierney, $5,000; W. F. Walsh, $1,500; J. C. Minahan, $500; J. D. Robinson, $1,500; Frank B. Abbott, $2,000; Dennis Maloney, $5,000; C. E. Davenport, $1,000. Mr. Brady purchased the stock of Mr. A. E. Powers, President of the Company, and the above order and proceedings were necessary to complete the formal transfer of the property to Messrs. Brady & Davenport, who represent the Troy Gas Company, which succeeds to the property of the Electric Light Company."

A CORRESPONDENT at Evansville, Ind., under date of June 21, writes: "Evidence of the very substantial growth of our city is found in the extension that will shortly be commenced by the Evansville Gas and Electric Light Company. Additional territory has been purchased by the Company in Heidelbach and Elsas' Enlargement, for the extension of its already large electric plant. The business has grown to the full capacity of the works, and the demand upon the resources of the latter is such as to warrant the betterment arranged for. A new building will be erected, the contracts for same having been let to Bedford & Wiechel and Bippus & Kanzler for the brick and carpenter work, respectively. The new structure will cost about $5,000, and will be constructed on modern lines. A 500-horse power engine will be installed in the new house, and, together with the cost of the electrical apparatus in connection with the plans, an expenditure of $100,000 will be involved. This electrical station will probably be the largest in the West, with the exception of that at St. Louis. It gives me great gratification to be able to add that ground has also been broken on adjacent property at the gas works for a tank to hold a gasholder with a capacity of 1,000,000 cubic feet. The site of the new holder is just opposite the present plant, on block 113, Lamasco. The cost of this will not fall short of $50,000. The city has grown fully up to the present capacity of the works, and these extensions are quite in line with the practice of the enterprising men—home capitalists, too—in control of the artificial lighting supply of Evansville."

THE contract for the new stock house (which is to be of iron) of the Isabella Furnace, at Barneston, Pa., has been awarded to the Berlin Iron Bridge Company, of East Berlin, Conn. The Bridge Company's design calls for the construction of an iron house, 54 feet in width by 100 feet in length, so arranged that loaded trains can pass beneath the structure. The Company is figuring on some retort house roof work.

ABOUT a fortnight ago two workmen entered a gas tank at Superior, Wis., that had been unused for 12 years. No attempt at ventilation had been made, and it was by the merest chance that the experimenters were rescued from death by suffocation.

BROTHER JUDGE, of the Rock Island (Ills.) Gas Company, is at his old trick of reducing gas prices, as he informs us, under date of June 18th, that, beginning with June 1st, an additional discount of 25 cents per 1,000 cubic feet will be allowed on all gas consumed at any residence where a gas cooking range is actually in use. This means a net charge in such situations of $1.50 per 1,000. Good judgment, that.

THE Charlestown (Mass.) Gas Company is making a very extensive series of improvements on its electric lighting plant. The betterments include an additional Armington & Sims engine, and a new boiler house (with an imposing chimney) rated to the satisfactory placing of 1,000-horse power. After a careful trial of different boiler settings the Company has determined to set the new boilers over the well-known Jarvis patent furnace, Mr. Neal being satisfied that the Jarvis plan is much superior to the other types tried at the Charlestown works. It looks somewhat superfluous to add that Treasurer and General Manager Neal, who is known to the gas men of this country as an able and conservative engineer, still keeps up in the front rank. He was one of the first to advocate the combination of gas and electric interests (we, however, still hold our opinion that locality alone can determine the wisdom of such a step), and the rapidity with which the Charlestown attempt has succeeded speaks for itself. Mr. Neal has been ably assisted in his work by his painstaking Superintendent, Mr. Coyle, who had full charge of the laying out and erection of the new plant. Those who visit Charlestown can count on looking over an excellently appointed and complete electric lighting station.

MR. HENRY D. HILL, of St. Louis, says that the erstwhile popular gasoline stove in that section is fast being replaced by the gas stove, and then adds: "With gas at the present rates it is true economy to use it in preference to gasoline, and with the probable introduction at an early date of fuel gas at 45 cents per 1,000, the use of gas stoves will not be confined to the summer months, but the greater part of domestic cooking will be done on them."

THE proprietors of the Las Vegas (New Mexico) Gas and Coke Company are well satisfied with the progress making on the betterment plans, the adoption of which was noted some time ago in these columns. Supt. Hart is our authority for the statement that the electric annex will be in working order by July 15th.

COL. WAGSTAFF, representing the bondholders of the Bay Shore (L. I.) Gas Company, bid in the property (which was offered at sheriff's sale) for the sum of $5,000. The liens amount to $30,000. Mr. John H. Golding will act as Superintendent. This ought to be a good place for a gas company, as Bay Shore is quite a pleasuring ground with a desirable class of summer residents, to say nothing of those who reside there permanently.

A VAGRANT flash of lightning at McKeesport, Pa., the other night caused quite a commotion in that usually placid burgh. Having burned out an electric lighting switch on an arc light at a clothing shop on the corner of Market street and Fifth avenue, nature's current found its way to a gas service that led into the house of Dr. Black. The Doctor was considerably worried over the prospective size of his next gas bill, but his mind is now at ease, as Superintendent Neemes, of the Gas Company, promised to "make it all right" if the Doctor would surrender the section of gas service that had been tapped by the electric visitor.

MISS ELLA KINGSBURY the accomplished daughter of Col. William A. Stedman, and Mr. Marion McAllister Smith were united by marriage at Newport, R. I., on the evening of Wednesday, June 18. The wedding took place in the Channing Memorial Church of that city, and was witnessed by a large assemblage of friends of the contracting parties. After the ceremony a reception was held at the home of the bride's parents, in Mount Vernon street, where a supper was served by Pinard. We extend to the newly-married couple our congratulations upon the happy event, and also our sincere wishes for their future happiness.

DEPOSITIONS are again being taken as a preliminary to the third trial of the case of the United Gas Improvement Company vs. the Manchester (N. H.) Gas Company.

WE are indebted to a St. Louis correspondent for the following, respecting the "strike" at gas capital in Quincy, Ills.—we make bold to say that when the Chicago cormorants succeed in bleeding Steinwedell and Littleton, they will have to come to the attack with sharper beaks than those now so prominently exposed: "A joint stock company has been organized by Chicago capitalists, with an asserted capital of $400,000, to put up an electric and gas light plant and a fuel gas plant for Quincy. The projectors ask the right to make such use of the city's streets as may be necessary for their purpose. The Company proposes to put its wires either above or below ground, as the city shall direct, and binds itself to furnish lighting gas for the next 5 years at $1.50 per 1,000 cubic feet. It will furnish fuel gas for the next 5 years at $1 per 1,000, provided, however, that if at the end of two years the total consumption of lighting and fuel gas amounts to 300,000 cubic feet per day then the price asked shall be $1.25 per 1,000 for illuminating gas and 90 cents for fuel gas; but, in any event, after 5 years the price of gas shall not be more than $1.25 and 90 cents for lighting and fuel gas respectively." This is a strike, pure and simple; and it will undoubtedly fail of its purpose.

MISS KREMERS, the accomplished daughter of the Secretary of the Milwaukee Gas Light Company, was united in marriage to Mr. H. A. Salzer on the 26th inst.

COLONEL STEDMAN has two months' leave of absence, and will leave Rochester to-morrow for Tacoma, Wash., from whence he will, on July 8th, sail for Alaska. He expects to be back in Rochester about September 1st, and does not expect to establish gas works in Sitka this trip, but will inspect the icebergs in Glacier Bay with a view, possibly, of utilizing their surfaces to reflect Northern lights over into the State of Washington. We hope the Colonel will have fair skies and balmy days as companions on the trip.

OUR contemporary, the *Berlineer*, reports the invention of a soft alloy which adheres so firmly to metallic glass and porcelain surfaces that it can be used as a solder, and which, in fact, is valuable when the articles to be soldered are of such a nature that they cannot bear a very high degree of temperature, the composition consisting of finely pulverized copper dust, which is obtained by shaking a solution of copper sulphate with granulated zinc. The temperature of the solution rises considerably and the metallic copper is precipitated in the form of a brownish powder—20, 30 or 36 parts of this copper dust according to the hardness desired, being placed in a cast iron or porcelain-lined mortar, and well mixed with some sulphuric acid having a specific gravity of 1.85. To this paste thus formed are added 70 parts by weight of mercury, with constant stiring, and when thus thoroughly mixed, the amalgam is well rinsed in warm water, to remove the acid, and then set outside to cool; in 10 or 12 hours it is hard enough to scratch tin. On being used it is heated to a temperature of 375° C. and when kneaded in an iron mortar it becomes as soft as wax. In this ductile state it can be spread on any surface, to which, as it cools and hardens, it adheres with great tenacity.

THE Fort Wayne Electric Company has issued the following circular, under date of June 16th, to its shareholders: "Pursuant to the authority given by the stockholders' vote adopted at the recent annual meeting of this Company, its capital stock has been increased by $1,000,000, divided into shares of $25 each. By this increase the Company acquires valuable patents, licenses and contracts, besides $450,000 in cash for working capital. The Company is thereby enabled to make still more complete and effective its present system of arc and incandescent lighting, and to prosecute its business more extensively and successfully than ever before. Arrangements have been made whereby each stockholder of record at the close of June 20, 1890, will have the right to purchase, within the time specified below, one share of the new stock for every three shares of the old that shall then be standing in his name on the books of the Company, the price at which the stock may be so purchased being $12.50 per share in cash. The rights of purchase pertaining to the new stock are assignable in writing. Fractional parts of shares cannot be issued either to stockholders of record or to parties acquiring 'rights' by assignment; and purchases of the new stock can be made only on 'rights' presented in lots of three or some multiple thereof. Agreements in writing for the purchase of the new shares will be received at the office of the International Trust Company, No. 45 Milk street, Boston, Mass., until and including Wednesday, June 25, 1890, but not afterwards, and the payments must be made to said Trust Company, in cash, on or before Saturday, June 28, 1890, on which day the stock certificates will be ready for delivery. All agreements to buy, though seasonably made and filed, may be declared void by said Trust Company unless the required cash payment shall be made to it on or before said June 28. By order of the Directors of the Fort Wayne Electric Company its transfer books will be closed from June 21 to June 25, both days inclusive.

IT is reported that a controlling interest in the Edison Illuminating Company's proposed plant at Milwaukee is owned by the Milwaukee Gas Light Company, or by certain of the shareholders in the latter corporation.

A SPECIAL from Yankton, S. Dak., bearing date of June 17th, says that a climax in the contest between the local electric light company and the Gas Company has been reached, in that Judge Smith has granted a temporary injunction restraining the city from contracting with the Gas Company for lighting, on the ground that the city cannot incur further indebtedness than exists. The case, which is attracting much attention in the Northwest, will be heard June 26. It seems likely the electric company will fail to secure a permanent injunction. If it is granted the case will be appealed and carried through to the bitter end.

THE Hon. Joseph H. Hanes has been appointed receiver of the assets of the Cape Island (N. J.) Gas Company.

THE Superior Court (Montreal, Canada) has given judgment for plaintiff (J. S. Brown) in the sum of $631 in his damage suit against the Montreal Gas Company. Although we gave the main details of the case (in our notice of the filing of the suit) some weeks ago, we herewith reproduce a summary of the same. The suit was for damages owing to the illness of plaintiff's wife from an escape of gas into their dwelling house, No. 13 Bishop street. Judge Gill held that the Gas Company was liable for all the costs Mr. Brown was put to in connection with Mrs. Brown's illness, and for the general discomfort occasioned in his household, especially as the Company was frequently notified to repair the leak from which the gas escaped in the Bishop street main. The Gas Company have a suit in warrant against the city, which they accuse of having done the damage by breaking the main with the heavy street roller.

A CORRESPONDENT at Wheeling, W. Va., says the Board of Trustees of the City Gas Works are bending all their energies at present in the direction of putting the works in first-class condition, and also increasing their capacity. To this latter end 4 new benches of 6 retorts each are being put in, and 12 benches of 6's are being thoroughly overhauled. The gasmaking machinery is also being overhauled, and repairs made to the big $40,000 holder, which has been leaking for some time back. As far as they are able, the Trustees will put in duplicate machinery at the works, to avoid jeopardizing the gas supply in the contingency of a break-down.

ASSOCIATED PRESS despatches, dated Trenton, N. J., June 24, are to the following effect: "The American Gas Investment Company filed a certificate of incorporation here to-day. The capital stock is $50,200,000, but only $10,000 is paid in. The stockholders named are: Geo. S. Bixby and Hector W. Thorne, of New York, and Wm. Talcott, of Paterson. The objects of the Company, as set forth in the charter, are to construct, acquire, own, manage and operate works for the manufacture, distribution and supply of light, heat and power by gas, electricity or otherwise, and generally to carry on any business incidental thereto, and to acquire the stocks and securities of other corporations formed for any similar purpose, and to deal in the same. The charter is worded like that of a trust, and it is believed here to be a reorganization of the Chicago Gas Trust, although it is also stated that it is a venture of English capitalists. The fee for the filing of the charter is $10,040, the largest the State has ever received.

THE Committee on Public Buildings, Salem, N. J., advertised for bids for lighting the Mayor's office and jail, for the term of 1 year, and in response thereto received tenders from the Salem Gas Light Company and the local Electric Light Company. The former offered to do the work for the sum of $140, while the electricians asked $160. The Salem Gas Company secured the award.

THE London *Journal* notes that the *Electrical Review* asks when we are to have a really reliable electric meter, which will be direct-reading, will not increase its records unduly as more current is passed through it, and will be fair alike to user and supplier. There is at present, we are informed, a meter in use which reads direct; but as fresh lamps are added to the circuit in which it is placed, it records an excess of current. Another gives indications which have to be multiplied by a constant, which is, of course, a decimal quantity, and therefore an unknown tool in the hands of the average householder. A third meter is a box of mystery, of the nature of which the consumer is in absolute ignorance, not unmixed with fear. He is told by the official of the electric lighting company who supply the instrument that so many hours' use of the current in the house will be recorded by an increase of weight in a plate inclosed in the box; and he is entirely at the mercy of the company. Consequently, it is no wonder that disputes arise. We know how it is with gas meters and consumers; and the gas meter is not only a positive measurer, while most, if not all, electricity meters are inferential, but it is also cheap and reliable in a degree that arouses the envy and despair of electricians.

THE Fidelity Trust Company, of Philadelphia, has been ordered to pay all money in its possession belonging to the Chicago Gas Company over to Receiver Davies. The latter will on receipt of the cash pay to shareholders the dividend recently declared.

MR. THOMAS E. LILLY, of St. Louis, Mo., has designed a sign to take the place of those formerly displayed on the gas street lamps for identifying the names of streets at crossings. It is a label triangular in form, and made to fit on the top of a post, to which it is fastened by a set screw. The lettering is white on a black ground, occupies two sides of the triangle, and is very distinct. The cardinal letters of the compass are also properly placed. The sign can be fitted to the electric light or telegraph poles.

SUPERINTENDENT WANTED

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By a man who can give the best of references. Thoroughly understands the manufacture and distribution of gas and the construction of works.

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A Six-Inch Exhauster.

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FOR SALE,

One 12-Inch Air Condenser.
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Six 12-Inch Chapman Valves.

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FOR SALE,

The Ironwork for Ten Benches of Fives (5's).

Cast iron Hydraulic Main, 16 by 18 in. Stand Pipes, 5 in. at bottom, 4 in. at top. Bridge and Dip Pipes, 4 in. Address DAYTON GAS LIGHT AND COKE CO.,

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Five 80-H.P. Ft. W. Bass Automatic Cut-Off Engines, 12 by 16 in.
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Four Tubular Boilers, Steel, 16 ft. by 60 in., forty-four 4 in. flues. Full front.
Two Tubular Boilers, Steel, 16 ft. by 60 in., eighty 3-in. flues. Full front.
One No. 5 Dean Pump.
Three Sets J. H. Turner Patent Heaters.

The above are in good condition and in operation. Write for particulars.

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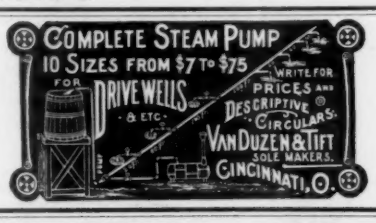
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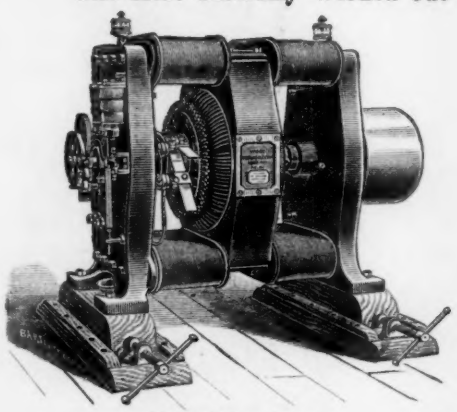

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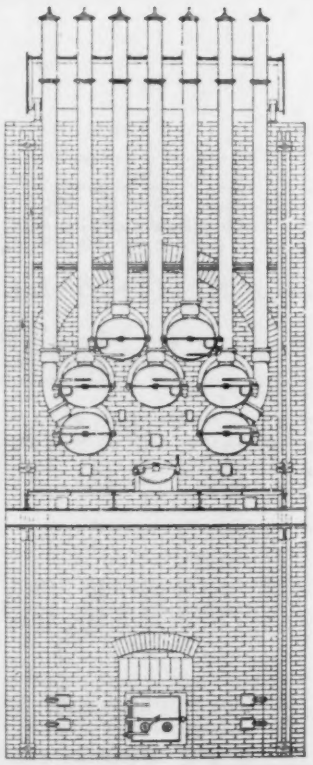

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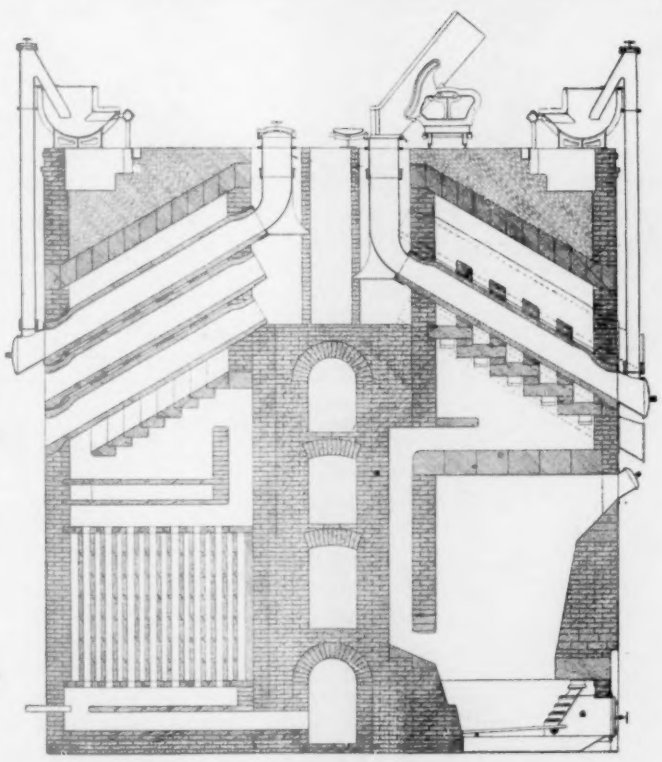

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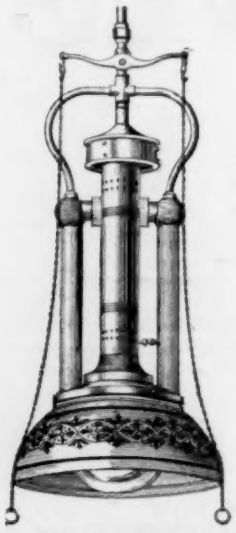

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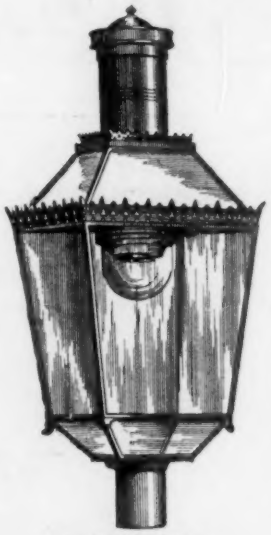

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OF

Incandescent Gas Lighting.

OFFICE, DREXEL BUILDING, PHILA., PA.

At the Fall Session of the Board of Supervisors of Winnebago County, held at the County Court House, Oshkosh, Wis., Nov. 26, 1889, the report submitted by Mr. C. W. Cook, Chairman of the Committee on Public Buildings, recommending the use of the Welsbach Incandescent Gas Burner in the Buildings under their charge, was unanimously adopted, because of the extreme economy in the consumption of Gas and the superior character of the light obtained.

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Governor Burners for Street Lamps & General Use

GOVERNORS FOR ARGAND AND OTHER COMMON GAS BURNERS IN ALL SIZES.

Horizontal Governors

Specially Adapted for Gas Stoves, Furnaces, etc.

It is well known that a large majority of all High Power Gas Lamps in the United States have my Governors attached, and they are always used by the leading makers of these lamps. To remove any excuse for the use by anyone of inferior and infringing Governors, a reduction in price has been made, and all exclusive contracts are cancelled.

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All Flames are Regulated by Direct Needle Valves.

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THE SPRINGER CUPOLA SYSTEM

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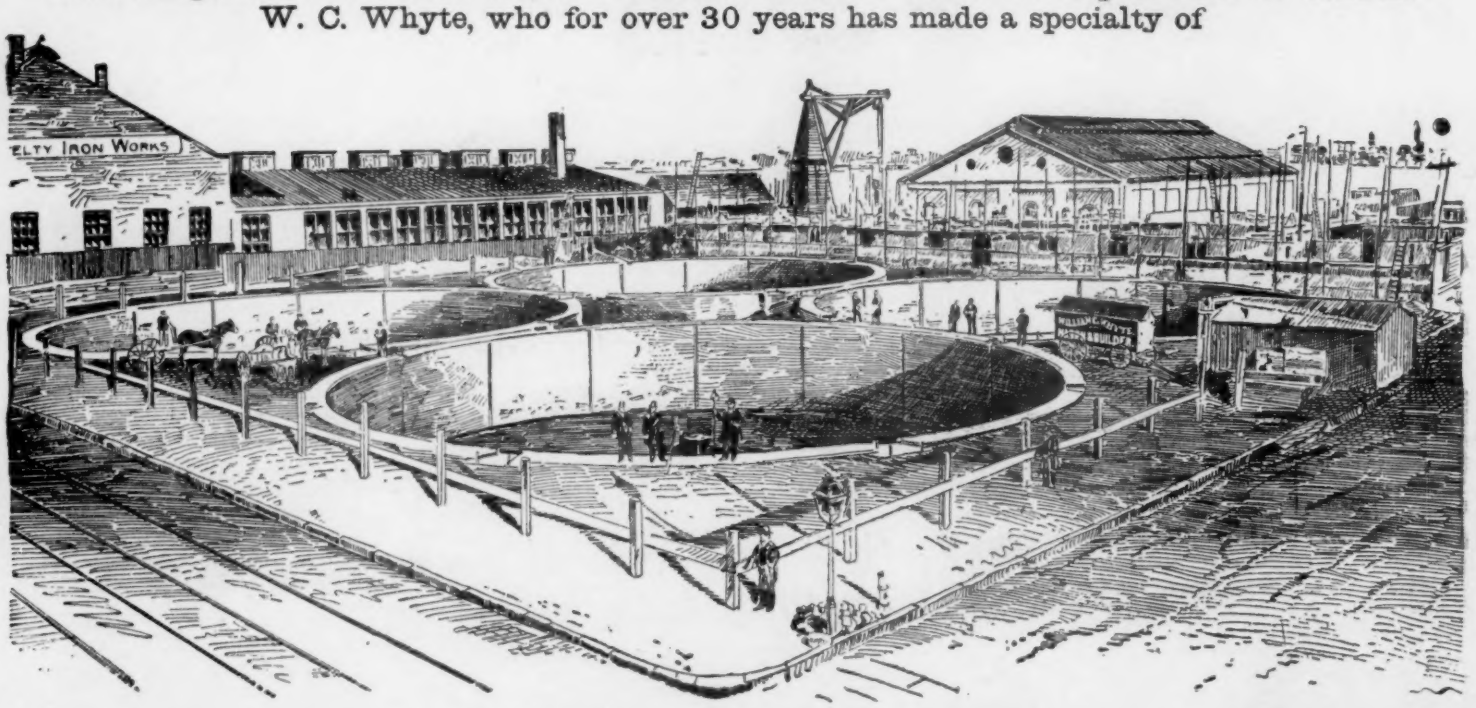

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Erected and in course of construction at present date:

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Altrincham	600,000
Adelaide	600,000
Aldershot	200,000
Allegheny, U. S. A.	1,000,000
Ashton-under-Lyne	1,250,000
Amsterdam	1,500,000
"	1,500,000
Annaberg	200,000
Arcachon	100,000
Animal Charcoal Co	200,000
Altoona, U.S.A.	350,000
Buxton	250,000
Bradford	1,000,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,000,000
"	1,000,000
"	3,000,000
Bremen	150,000
Baltimore, U.S.A.	1,000,000
"	1,000,000
"	1,000,000
Balmain, N.S.W	125,000
Bishops Stortford	150,000
Blackpool	400,000
Brussels	1,250,000
"	1,250,000
"	750,000
"	1,250,000
Banbury	250,000
Birmingham	5,000,000
Birkenhead	2,500,000
Blackburn	1,500,000
Bochum	600,000
Burntisland	250,000
Boston, U.S.A.	2,000,000
Brisbane	1,500,000
"	300,000
Burton-on-Trent	1,500,000
Barcelona	350,000
Barking	100,000
Baerlien & Co	20,000
"	20,000
Bombay	400,000
Buffalo, U.S.A., Mutual	750,000
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Brookline, U.S.A.	500,000
Bergen	350,000
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Bournemouth	1,000,000
Bridgeport, U.S.A.	500,000
Brunswick	300,000
Beck & Co., St. Louis	100,000
Barmen Rittershausen	600,000
Bexhill	125,000
Brooklyn, U.S.A.	1,000,000
"	1,000,000
" **Nassau**	1,000,000
Brunner, Mond & Co.	400,000
Cheltenham	2,000,000
Cannes	200,000
Croydon	1,500,000
Copenhagen	200,000
Clevedon	200,000
Columbus, U.S.A.	500,000
Cincinnati, "	1,500,000
" "	1,500,000
Chicago "	3,000,000
" "	1,000,000
" "	1,000,000
Chemnitz	1,000,000
Crewe	1,250,000
Colonial Gas Works Co	100,000
Cadiz	300,000
Charlottenburg	600,000
Dudley	750,000
Driffield	100,000
Dukenfield	500,000
Dover	750,000
"	1,000,000
Deal	200,000
Derby	1,500,000

	Capacity. Cubic feet per day.
Dublin	3,000,000
Dowlais	100,000
Douai	500,000
Denton	500,000
Derby, U.S.A.	350,000
Denver, "	500,000
" "	1,000,000
Dusseldorf	750,000
"	500,000
Dumfries	250,000
Dunedin, N.Z	400,000
Darlington	1,250,000
Detroit, U.S.A.	750,000
Edinburgh	1,500,000
"	2,000,000
Enfield	300,000
Essen	300,000
Elbing	150,000
Falmouth	150,000
Frankfort	300,000
Farnworth	400,000
Fenton	400,000
Friedenshutte	500,000
Furth	400,000
Freiburg	200,000
Goole	250,000
Glossop	300,000
Guildford	300,000
Gloucester	1,250,000
Gera	300,000
Grafton, N.S.W	100,000
Grieg	300,000
Georgetown, U.S.A.	250,000
Gluckauf	200,000
Heywood	600,000
Holywood	125,000
Huy	70,000
Harrow	250,000
Harrogate	250,000
Halstead	150,000
Heilbronn	200,000
Havana, Cuba	750,000
Hastings	1,500,000
Huddersfield	300,000
"	750,000
"	1,500,000
Hof	200,000
Hampton Wick	500,000
Heckmondwicke	500,000
Haverfordwest	100,000
Halifax, N.S.	350,000
Hamm	200,000
Halle	400,000
Heidelberg	300,000
Hartford, U.S.A.	1,000,000
Ilkeston	300,000
Inverness	250,000
Ilkley	200,000
Ilford	100,000
Kingston-on-Hull	400,000
Kidderminster	750,000
Kidsgrove	100,000
Konigberg	1,000,000
King's Lynn	300,000

LONDON:—

The Gaslight and Coke Co.:	
Beckton	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	2,500,000
"	2,500,000
Silvertown	1,000,000
Bromley	2,000,000
"	1,500,000
"	1,500,000
"	1,500,000
"	2,000,000
"	1,500,000

LONDON—*Continued.*	Capacity. Cubic feet per day.
Shoreditch	2,500,000
Pancras	1,500,000
"	1,500,000
Pimlico	2,000,000
Nine Elms	3,000,000
"	3,000,000
South Metropolitan Co:—	
Greenwich	3,000,000
Woolwich	400,000
Vauxhall	3,000,000
"	3,000,000
Lea Bridge	300,000
West Ham	1,500,000
Leeds	2,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	2,000,000
Leominster	150,000
Leiden	500,000
"	600,000
Liverpool	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	3,000,000
Lincoln	1,000,000
"	600,000
Lowell, U. S. A.	1,000,000
Louisville "	1,500,000
Long Eaton	500,000
Lilie	900,000
"	450,000
"	750,000
"	250,000
"	250,000
Luckenwalde	330,000
Liegwitz	300,000
Lincoln, U. S. A.	250,000
Lawrence "	500,000
Lynn "	300,000
Lyons	1,500,000
Maidstone	1,000,000
Marseilles	1,500,000
"	1,500,000
Mons	500,000
Malines	250,000
Melbourne	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
Manchester	2,500,000
Middleton	400,000
Manley, N. S. W.	100,000
Minneapolis, U. S. A.	750,000
Magdeburg	300,000
Memphis, U. S. A.	750,000
Nottingham	1,250,000
"	2,500,000
"	2,500,000
"	2,000,000
"	1,500,000
"	2,000,000
Newport, U.S.A.	430,000
Newmarket	150,000
Newark, U.S.A.	680,000
Northfleet	200,000
New York, U.S.A.	2,000,000
Nice	600,000
Newcastle, N. S. W.	200,000
Numea, "	100,000
Namur	250,000
Newark	350,000
Oldbury	500,000
Otley	200,000
Oswestry	250,000

	Capacity. Cubic feet per day.
Ober Schlesian	1,500,000
Otto & Co.'s Coke Works	1,500,000
Plymouth	2,000,000
Parramatta, N. S. W.	100,000
Prescott	150,000
Providence, U.S.A.	750,000
"	750,000
Plauen	300,000
"	300,000
Portsmouth	2,500,000
"	2,500,000
Pittsburgh, U.S.A.	1,500,000
Portland, "	560,000
Pawtucket, "	500,000
Quebec	250,000
Radcliffe	750,000
Rouen	250,000
Ramsgate	1,000,000
Reigate	200,000
Richmond, U.S.A.	250,000
Roxbury, "	500,000
Runcorn Soap Co.	20,000
Rockhampton, N. S. W.	125,000
Richmond	1,500,000
Reading	2,000,000
Reichenbach	200,000
Salford	1,750,000
"	1,750,000
"	1,750,000
Smethwick	750,000
Sydney, N. S. W.	1,000,000
"	1,000,000
"	2,500,000
"	50,000
"	50,000
Sunderland	1,500,000
St. Josephs, U.S.A.	250,000
Spa	100,000
Sevenoaks	300,000
St. Petersburg	2,000,000
"	1,500,000
St. Louis, U.S.A.	2,000,000
"	2,000,000
"	1,000,000
Laclede	1,000,000
Silesian Coal Co.	600,000
San Francisco, U.S.A.	2,000,000
"	2,000,000
Sheepbridge Coal Co.	40,000
Stettin	200,000
Singapore	300,000
Sutton	500,000
Tonbridge	150,000
Tipton	400,000
Tottenham	1,000,000
Toledo, U.S.A.	750,000
Toronto	1,000,000
Uxbridge	300,000
Valparaiso	500,000
West Bromwich	1,000,000
Willenhall	250,000
Weston-super-Mare	500,000
Waltham	150,000
Wormwood Scrubs	300,000
Williamsburg, U.S.A.	600,000
"	600,000
Wellington	150,000
Warwick	300,000
Wheeling, U.S.A.	500,000
Walker	300,000
Westgate	100,000
Wilmington, U.S.A.	500,000
Windsor, N. S. W.	100,000
Wolverton	100,000
Wellington, N. Z.	250,000
Whitchurch	175,000
Washington, U.S.A.	2,000,000
Wallasey	750,000
Weimar	150,000
Wurzen	200,000
Worcester, U.S.A.	750,000
Yeadon	500,000
Yeovil	250,000

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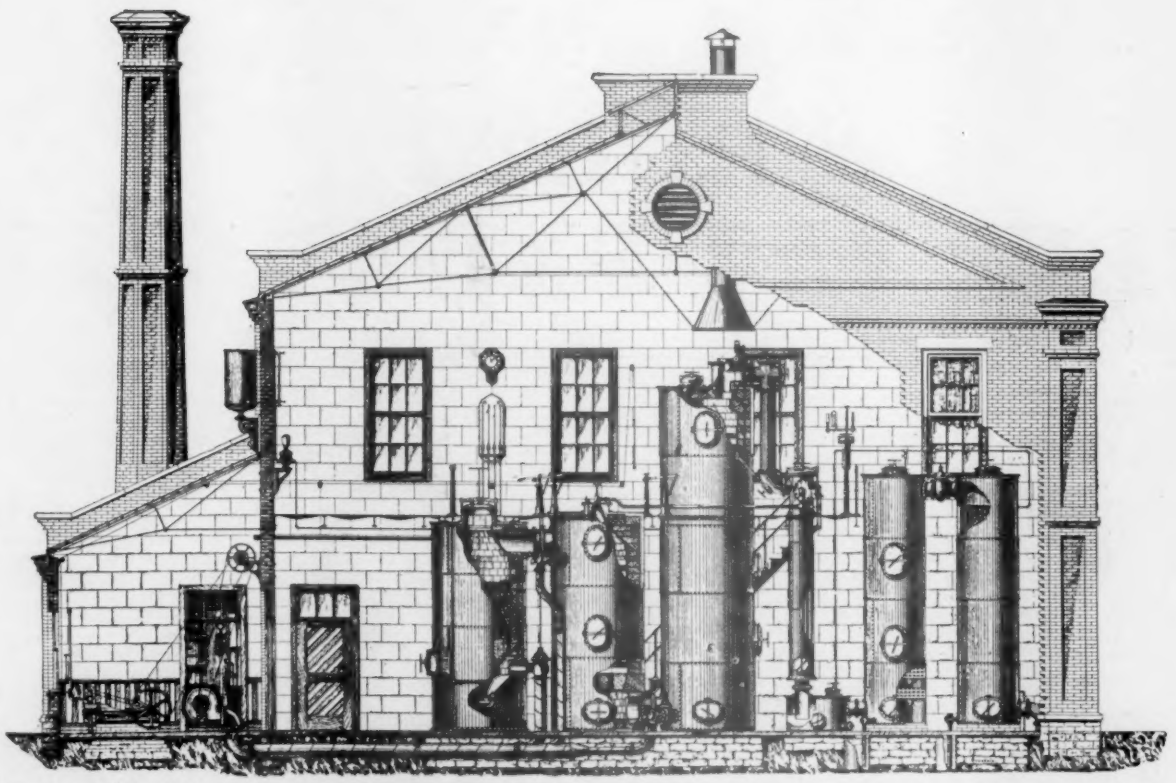

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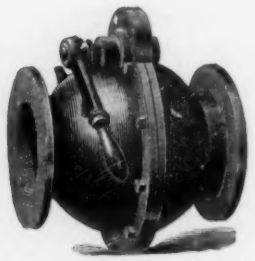

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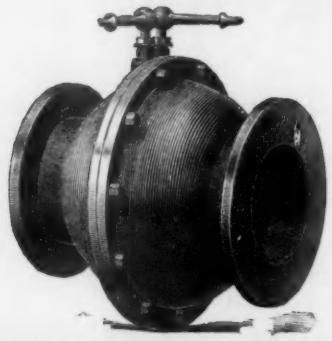

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Reliable
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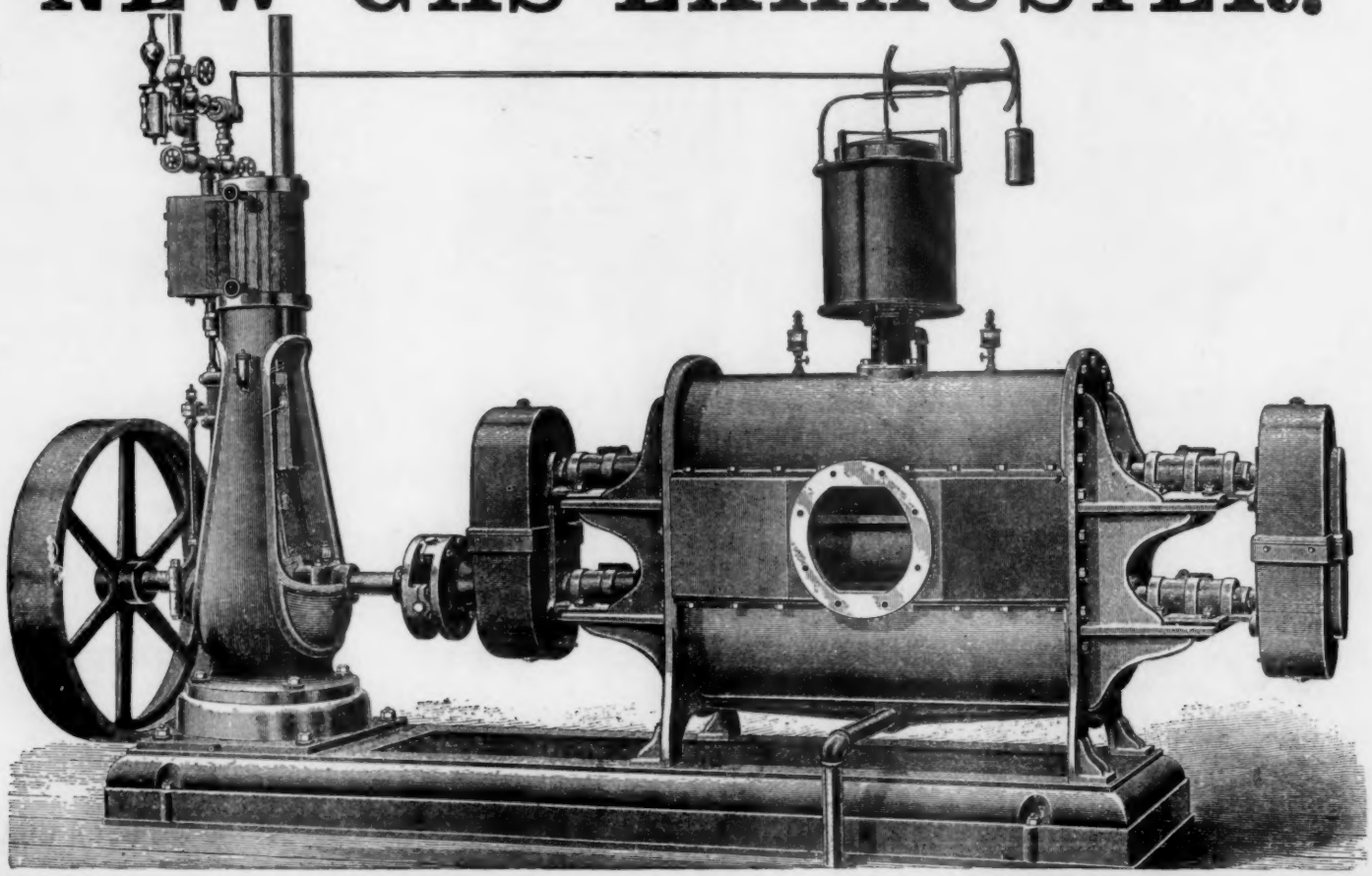

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AUTOMATIC GOVERNOR. Has been on the market but *three years*, and in that time has been introduced *more generally* than any invention ever designed for use in gas works. Over *two hundred* of them now in use. Sensitive; reliable; perfectly automatic; reduces leakage; satisfies consumers, and gives great relief to the Manager. No gas works is *complete* without one of these machines.

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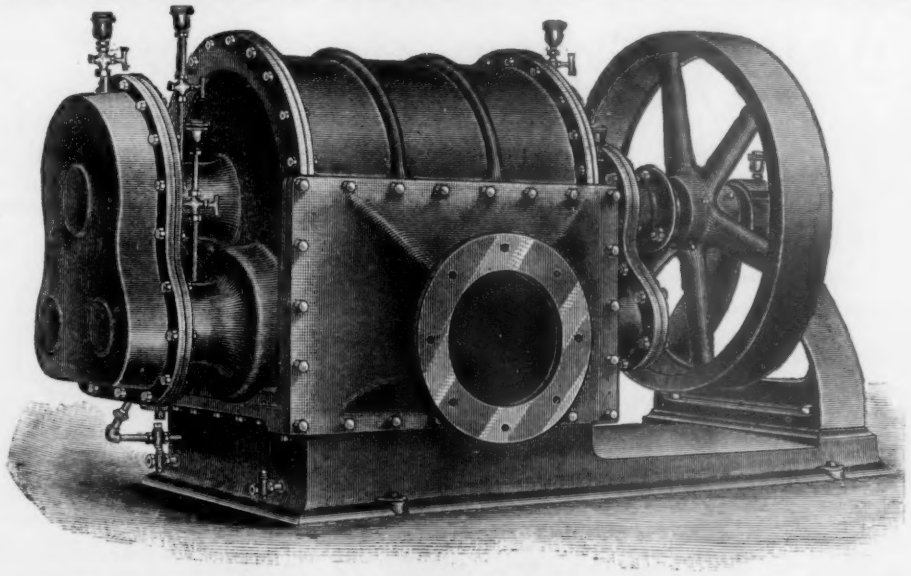

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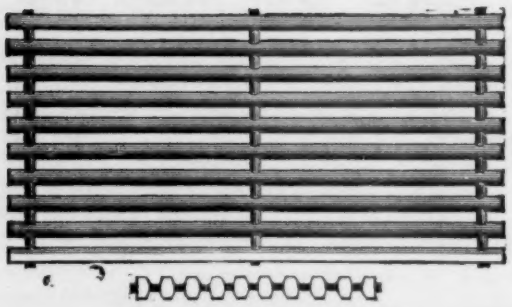

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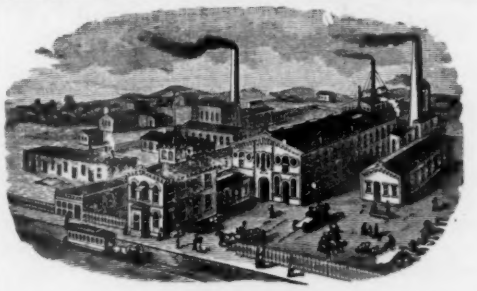

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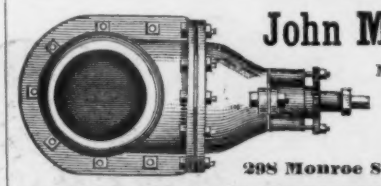

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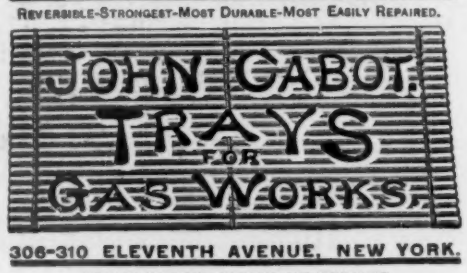

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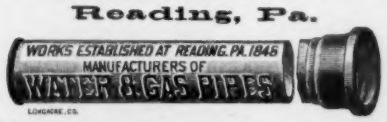

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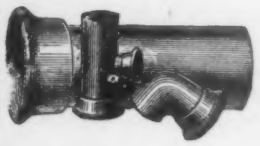

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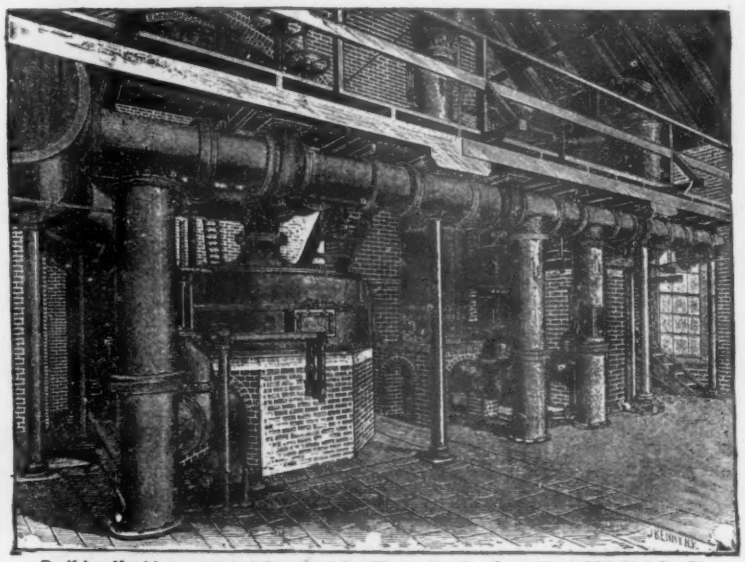

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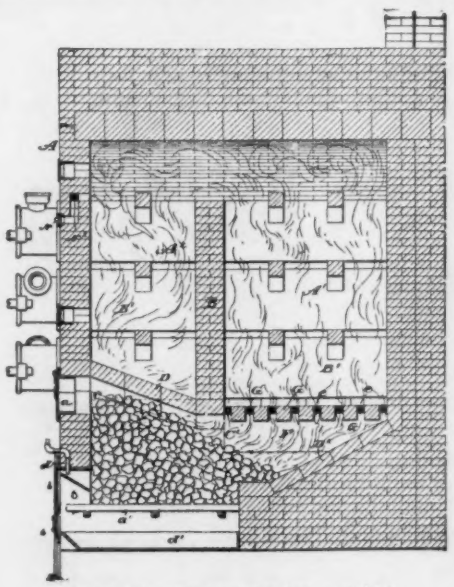

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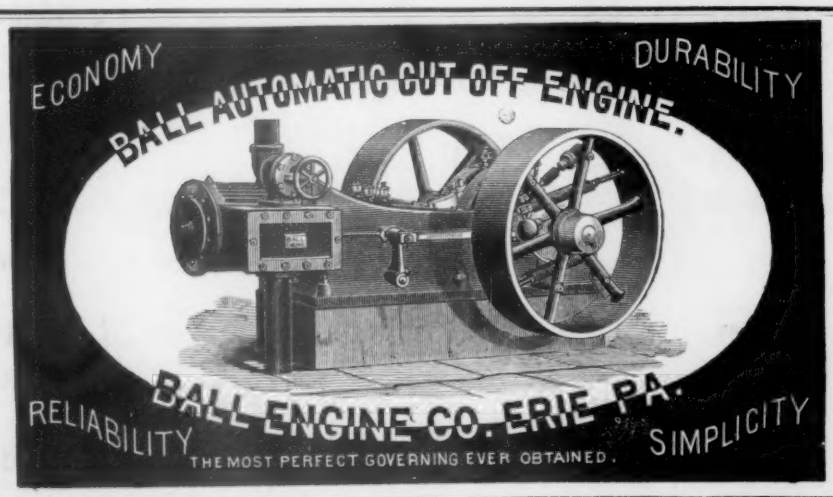

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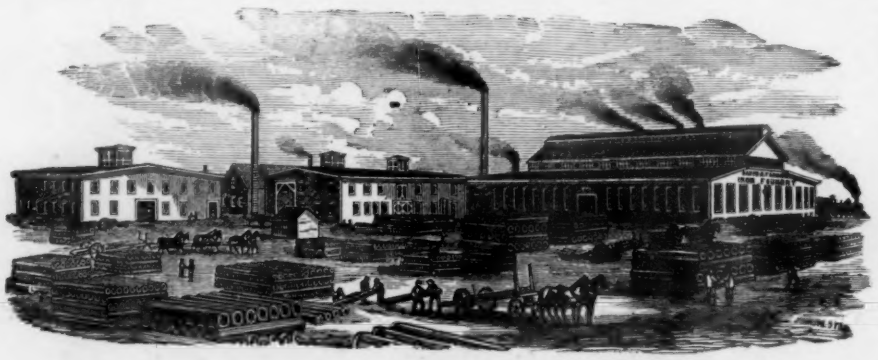

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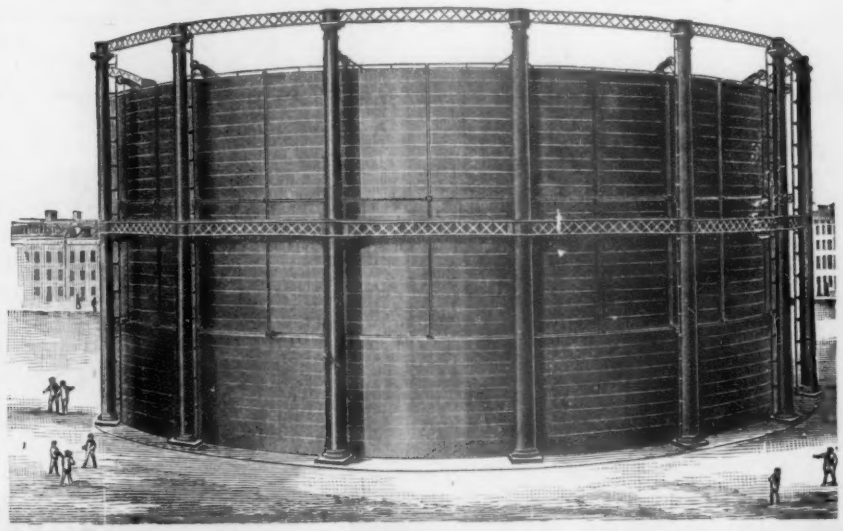

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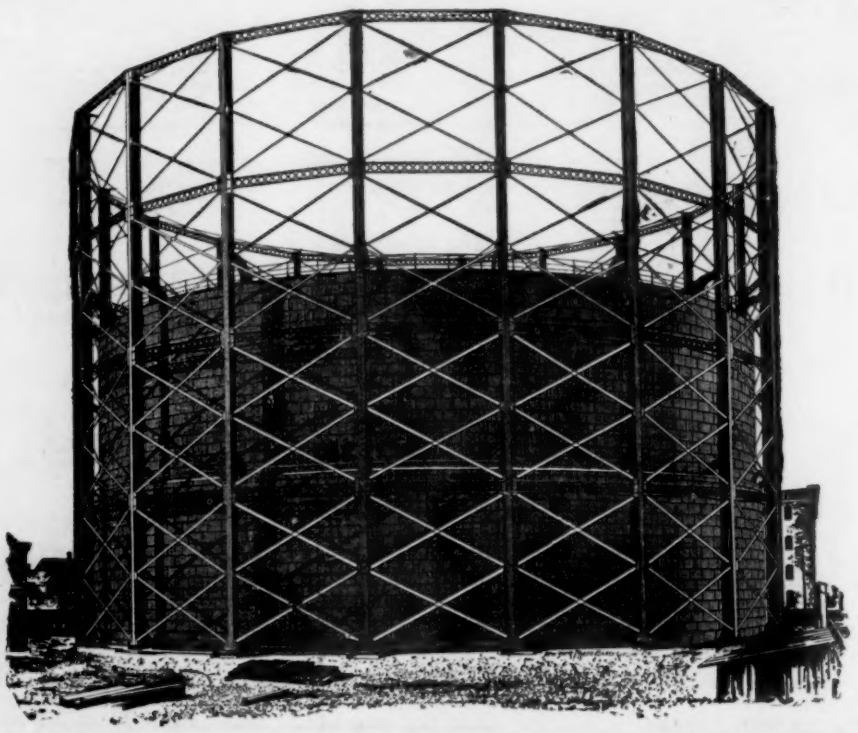

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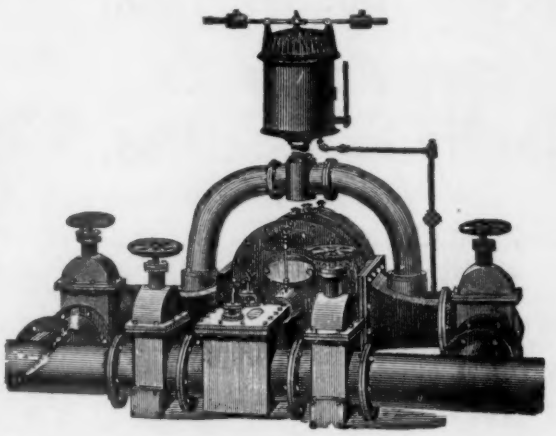

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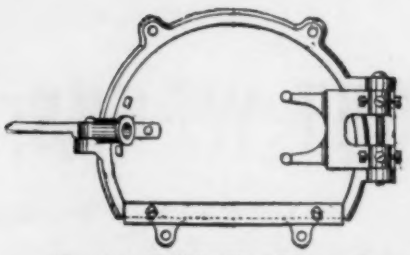

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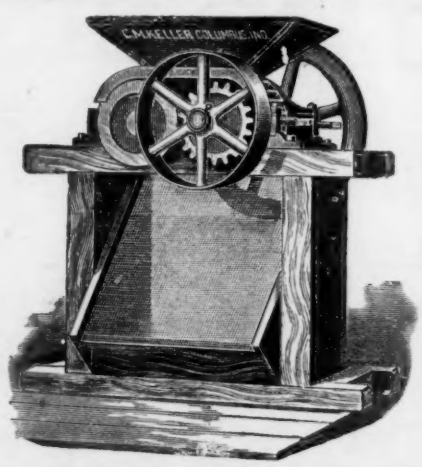

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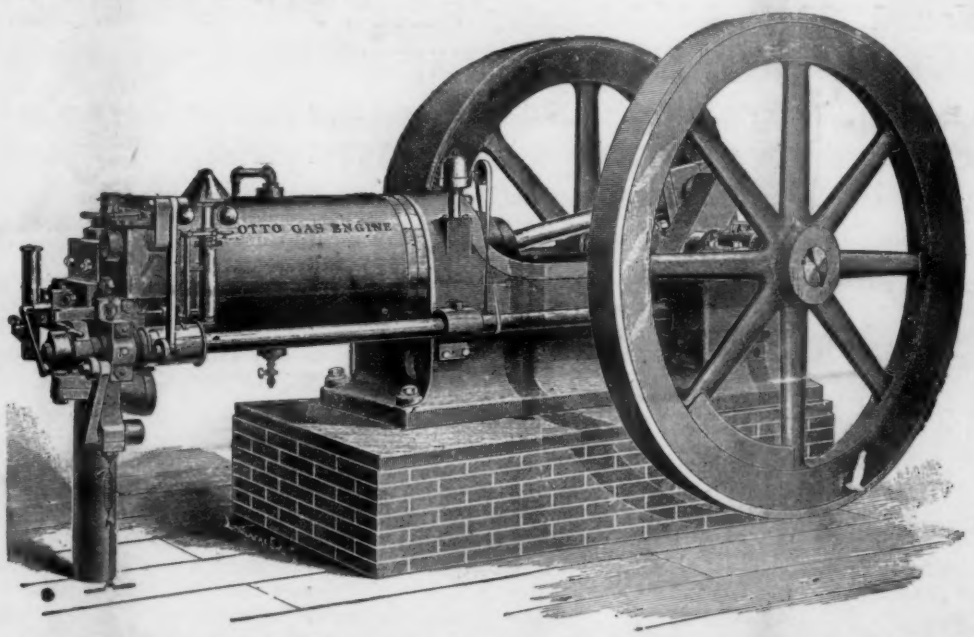

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